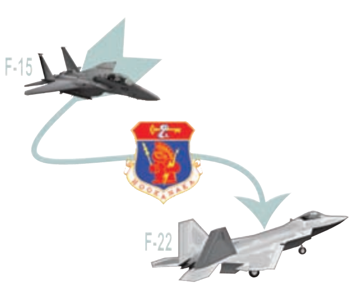
Replacement of F-15 Aircraft with F-22A Aircraft

Hickam Air Force Base, Hawaii

Environmental Assessment



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14. ABSTRACT

This EA has been prepared in accordance with the National Environmental Policy Act (NEPA). Potentially affected environmental resources were identified through public scoping, communication with local, state, and federal agencies, and review of past documentation. In addition, letters were sent to Native Hawaiian groups soliciting their input. Specific environmental resources with the potential for environmental consequences include airspace management, noise, safety, air quality, physical resources biological resources, cultural resources, land use and transportation, socioeconomics, and environmental justice. Airspace management and air traffic control includes changes in the fighter approach pattern to Hickam AFB to reduce the potential for noise effects. These changes would not significantly affect either the airspace or air traffic control. Military aircraft average daily operations represent approximately 5 to 6 percent of the total 880 daily flights to the joint use Honolulu International Airport/Hickam AFB. Military average daily operations would increase from 53 with the F-15 to 65 with the F-22A. Training in offshore airspace would have no effect on airspace management or air traffic control. Comparable take-off noise would occur with the F-15 (normally with afterburner) and the F-22A (with powerful engines that predominantly do not need afterburner). During landing, the proposed F-22A approach pattern would result in no discernible change to off-installation noise. In the overwater airspace, F-22A operations would produce more sonic booms than the F-15. The air-to-water interface attenuates sonic booms and rapidly reduces their intensity in the underwater environment. Design elements associated with infrastructure planning efforts should improve safety concerns. The F-22A would meet the Hawaii Air Defense requirements and operational training using live air-to-air munitions comparable to those used by the F-15. No F-22A air-to-ground munitions would be used in the Hawaiian Islands. The F-22A would use an estimated 2,318 fewer bundles of chaff and 784 fewer flares than are currently used by the F-15s during overwater training. The Honolulu area is in air quality attainment and no air quality impacts are projected. Natural resources findings demonstrate that no practicable alternative exists for construction of some HIANG facilities within the 100- year floodplain. F-22A chaff produces more pieces of residual plastic or mylar than F-15 chaff. F-22A training would increase residual materials from the current 0.25 - 5.8 pieces to 0.6 - 13 pieces per square mile per year under offshore training airspace. Although not significant, any deposition of plastic or mylar materials in the northern Pacific Ocean could contribute to the amount of such materials entering the marine food chain. Sonic booms do not transfer to the water at sound levels that could harm or harass marine

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Replacement of F-15 Aircraft with F-22A Aircraft
Hickam Air Force Base, Hawaii

Our goal is to give you a reader-friendly document that provides an in-depth, accurate analysis of potential environmental consequences. The organization of this Environmental Assessment, or EA, is shown below:

Acronyms and Abbreviations can be found on the inside back cover.

How to Use This Document

This EA is prepared to help the reader understand the potential environmental consequences of the Proposed Action. Please review Chapter 1.0 and 2.0 to learn the purpose and details of the proposed replacement of F-15 aircraft with F-22A aircraft beginning in 2011.

Chapter 3.0 explains the affected environment of the Proposed Action at Hickam AFB and in the off shore airspace. The No Action Alternative is also addressed.

Chapter 4.0 explains the environmental consequences of the Proposed Action at Hickam AFB and in the off shore airspace. The No Action Alternative is also addressed.

Chapters 5.0 through 7.0 discuss cumulative impacts, contain references, and include a list of preparers.

In addition to the main text, a series of appendices describe chaff and flares, public involvement, air quality emissions, airspace operations, and noise analysis.

Public and Agency comments on the Draft EA are summarized in Table 2.4-3 and incorporated throughout this EA.

The box to the left summarizes the EA contents.

Cover Sheet

ENVIRONMENTAL ASSESSMENT (EA) FOR THE REPLACEMENT OF F-15 AIRCRAFT WITH F-22A AIRCRAFT AT HICKAM AIR FORCE BASE (AFB)

a. *Responsible Agency:* United States Air Force (Air Force)

b. *Cooperating Agency:* None

c. *Proposals and Actions*: This EA analyzes the potential environmental consequences of a proposal to replace F-15 aircraft with F-22A aircraft at Hickam AFB, Hawaii. Hickam AFB is: (1) an existing AFB with an F-15 air superiority mission, established support for fighter aircraft, access to adequate training airspace, support for varied training opportunities, and available infrastructure and communication links, (2) has the ability to integrate Air National Guard (ANG) experience with the capabilities of the active Air Force as part of the national mission in the ongoing Global War on Terrorism, and (3) locates advanced U.S. weapon systems on the Pacific Rim where they can rapidly respond to existing and projected national threats. The F-22A air-to-air and air-to-ground operations use low observability, increased situational awareness, and speed to overcome adversaries and ensure air dominance over any battlefield.

The proposed Air Force and Hawaii ANG (HIANG) initiative is to replace 15 Primary Aircraft Inventory (PAI), 2 Backup Aircraft Inventory (BAI), and 3 Reserve Aircraft Inventory F-15s (20 aircraft) with 18 PAI and 2 BAI F-22As (20 aircraft). Beginning in Fiscal Year (FY) 2011, F-22As would occupy the same HIANG location on the southern part of Hickam AFB currently occupied by the comparably sized F-15s. An estimated 20 facilities would be renovated and/or constructed over a 5-year period at a cost of approximately $146.4 million in FY 2007 dollars. F-22As would fly approximately 50 percent more missions than the F-15s in existing offshore airspaces currently used by the F-15s. As with the F-15s, the F-22As would conduct operations with defensive flares, chaff, and air-to-air munitions in approved overwater airspaces.

No Action at Hickam AFB means no replacement of the F-15 squadron by the F-22A squadron at this time.

d. *For Additional Information*: Contact HIANG Public Affairs, Captain Regina Berry, (808) 733-4258.

e. *Designation*: Environmental Assessment

f. *Abstract*: This EA has been prepared in accordance with the National Environmental Policy Act (NEPA). Potentially affected environmental resources were identified through public scoping, communication with local, state, and federal agencies, and review of past documentation. In addition, letters were sent to Native Hawaiian groups soliciting their input. Specific environmental resources with the potential for environmental consequences include airspace management, noise, safety, air quality, physical resources, biological resources, cultural resources, land use and transportation, socioeconomics, and environmental justice.

Airspace management and air traffic control includes changes in the fighter approach pattern to Hickam AFB to reduce the potential for noise effects. These changes would not significantly affect either the airspace or air traffic control. Military aircraft average daily operations represent approximately 5 to 6 percent of the total 880 daily flights to the joint use Honolulu International Airport/Hickam AFB. Military average daily operations would increase from 53 with the F-15 to 65 with the F-22A. Training in offshore airspace would have no effect on airspace management or air traffic control.

Comparable take-off noise would occur with the F-15 (normally with afterburner) and the F-22A (with powerful engines that predominantly do not need afterburner). During landing, the proposed F-22A approach pattern would result in no discernible change to off-installation noise. In the overwater airspace, F-22A operations would produce more sonic booms than the F-15. The air-to-water interface attenuates sonic booms and rapidly reduces their intensity in the underwater environment. Design elements associated with infrastructure planning efforts should improve safety concerns. The F-22A would meet the Hawaii Air Defense requirements and operational training using live air-to-air munitions comparable to those used by the F-15. No F-22A air-to-ground munitions would be used in the Hawaiian Islands. The F-22A would use an estimated 2,318 fewer bundles of chaff and 784 fewer flares than are currently used by the F-15s during overwater training. The Honolulu area is in air quality attainment and no air quality impacts are projected.

Natural resources findings demonstrate that no practicable alternative exists for construction of some HIANG facilities within the 100-year floodplain. F-22A chaff produces more pieces of residual plastic or mylar than F-15 chaff. F-22A training would increase residual materials from the current 0.25 - 5.8 pieces to 0.6 - 13 pieces per square mile per year under offshore training airspace. Although not significant, any deposition of plastic or mylar materials in the northern Pacific Ocean could contribute to the amount of such materials entering the marine food chain. Sonic booms do not transfer to the water at sound levels that could harm or harass marine species.

None of the base buildings proposed for renovation or demolition meets the designation as an historic structure. The Fort Kamehameha historic district would not be affected by renovation or demolition of buildings in the HIANG area. No known Native Hawaiian traditional cultural sites or historic properties are projected to be impacted by HIANG facilities construction or F-22A operations.

Noise to off-installation land uses would not change with the proposed F-22A approach pattern being coordinated by the HIANG and FAA. There would not be any noticeable change in HIANG personnel levels within the Honolulu economy. HIANG aircraft replacement would not have a disproportionate impact on minority or low-income populations. There would be no impact upon children. There are no significant cumulative impacts from the F-22A replacement when considered with past, present, and reasonably foreseeable projects.

FINDING OF NO SIGNIFICANT IMPACT (FONSI)
AND
FINDING OF NO PRACTICABLE ALTERNATIVE (FONPA)
FOR
REPLACEMENT OF HAWAII AIR NATIONAL GUARD F-15 AIRCRAFT WITH F-22A AIRCRAFT AT HICKAM AIR FORCE BASE, HAWAII

PURPOSE: The purpose of the proposed action to replace Hawaii Air National Guard (HIANG) F-15s with F-22As is to have national security assets positioned to rapidly respond to the directives of the President and Secretary of Defense and to provide the United States Air Force (Air Force) with the capability to rapidly deploy to anywhere in the Pacific Rim. For over two decades there has been a HIANG F-15 squadron at Hickam Air Force Base (AFB) with the organizational structure and infrastructure to support air superiority fighter aircraft. The HIANG has an air superiority mission, has operational air superiority experience, and has extensive over-water training airspace to meet the needs for an F-22A operational squadron.

PROPOSED ACTION: The Air Force and Air National Guard (ANG) propose to replace the HIANG F-15 aircraft with F-22A aircraft at Hickam AFB beginning in Fiscal Year (FY) 2011. The proposal is to replace the 15 Primary Aircraft Inventory (PAI) F-15s, 2 Backup Aircraft Inventory (BAI) F-15s, and 3 Reserve Aircraft Inventory F-15s (20 total aircraft) with 18 PAI F-22As and 2 BAI F-22As (20 total aircraft). The replacement F-22A aircraft would occupy the same HIANG location on the southern part of Hickam AFB currently occupied by the comparably-sized F-15 aircraft. The F-22A squadron would need renovation and/or construction of an estimated 20 facilities to support the F-22A aircraft. Renovation and construction would be projected to occur over a 5-year period at a cost of approximately $146.4 million in Military Construction (MILCON) and Operations and Maintenance (O&M) dollars. Additional PAI F-22A aircraft and the projected improved maintenance capabilities of the F-22A mean that the F-22A would fly approximately 50 percent more missions from Hickam AFB than are currently flown by the F-15.

NO ACTION ALTERNATIVE: No Action at Hickam AFB means no replacement of the F-15 squadron with an F-22A squadron at this time. No Action could affect future mission capabilities of the Pacific Air Forces (PACAF). No Action is equivalent to baseline conditions at Hickam AFB, which include the HIANG operational F-15 squadron and F-15 aircraft training in the offshore Warning Areas and Air Traffic Control Assigned Airspaces (ATCAAs) north and south of Oahu.

SUMMARY OF FINDINGS:

Potentially affected environmental resources have been identified through public scoping meetings, communications with state and federal agencies, and review of past environmental documentation. In addition, letters were sent to Native Hawaiian groups soliciting input. Specific environmental resources with the potential for environmental consequences include airspace management and air traffic control (including airport traffic), noise, safety, air quality, physical (including water) resources, biological resources, cultural resources, land use (including recreation and transportation), socioeconomics, and environmental justice.

Hickam AFB is a joint use facility with Honolulu International Airport. The airport supports approximately 880 daily flights, of which approximately 5 to 6 percent are military flights. Military average daily operations, including based and transient aircraft, would increase from 53 with the F-15 to 65 with the establishment of the F-22A squadron. The HIANG and the Federal Aviation Administration (FAA) continue to coordinate and identify workable solutions for the F-22A as they have done for the F-15. The HIANG will leverage the experiences from the F-15 approved practices that minimize noise consequences surrounding communities when developing procedures in conjunction with the FAA for the F-22A aircraft. Airspace management for the airfield and the airspace would not have a significant impact.

F-22A engines are more powerful and louder than F-15 engines. Noise in the environs of Hickam AFB and Honolulu International Airport is dominated by commercial traffic, which represents 94 to 95 percent of the daily aircraft operations. The HIANG is currently working with the FAA to propose a landing approach which avoids the straight-in pattern and increases approach altitudes. With these revised patterns, application of recognized noise models demonstrates essentially no discernible change in off-base noise associated with the replacement of F-15s with F-22As.

Existing offshore training airspace would be used for F-22A training. In the overwater airspace, there would be an increased number of sonic booms. The altitude of F-22A training, which in general is higher than that for the existing F-15s, would result in many of these sonic booms being detected as distant thunder. The air-to-water interface attenuates booms and rapidly reduces their intensity to the underwater environment. Recreational areas near the HIANG and overwater recreational activities could experience increased sonic boom effects, but would not be significantly impacted by replacing the F-15 aircraft with F-22A aircraft.

The F-22A would fly with live air-to-air munitions comparable to those used by the air defense requirements and training. The F-22A would have increased on-base safety arcs over those of the F-15 and the Explosive Safety Plan for Hickam AFB would require an update in accordance with Air Force Instruction (AFI) 91-201. No significant impacts are expected to safe on-base operations. New and improved HIANG facilities would permit incorporation of current safety technology. This includes safety setback locations and improved maintenance facilities. This is projected to have no noticeable change in bird aircraft strike hazards risk.

The Honolulu area is in air quality attainment for all criteria pollutants. Temporary construction emissions could produce localized short-term, elevated emissions. Some construction and renovation would replace older equipment with new, lower emission equipment. Local air quality or visibility would not be significantly affected from construction or operations. No change is projected to air quality within the Honolulu area, and no conformity determination is required.

On-base renovation and construction would occur at several previously disturbed locations within the HIANG area on Hickam AFB. National Pollution Discharge Elimination System (NPDES) storm water permits and the site specific Storm Water Pollution Control Plan (SWPCP) (also referred to as Storm Water Pollution Prevention Plan [SWPPP]) would be updated with best management practices (BMPs). Improvements to handle storm water surges would be designed into new facilities. New environmentally controlled facilities would be constructed to support maintenance of low-observability coatings on F-22A aircraft. No significant effects would occur to earth or water resources, hazardous materials, hazardous wastes, or the Installation Restoration Program (IRP) (also known as Environmental Restoration Program [ERP]). Effects to marine resources under the airspace would be comparable to those currently existing with F-15 training. The different F-22A chaff, sizes of the airspace, and the amount of chaff and flare use would result in 0.6 to 13 pieces of plastic or Mylar material being deposited annually per square mile of ocean under the training airspace. Although this is more than the current 0.25 to 5.8 pieces per square mile under the training airspace with the F-15 training, no significant impact is expected from this change.

Demolition or construction of facilities would occur on previously disturbed HIANG areas. Construction and base aircraft operations would not be expected to impact sensitive biological resources. Sonic booms in the airspace would not be expected to transfer from the air to the water at sound levels that could result in harm or harassment to marine mammals or other marine species. Plastic or Mylar pieces of debris from chaff or flares are inert and are currently randomly distributed under the airspace. Although not significant, any deposition of plastic or Mylar materials in the northern Pacific Ocean could increase the amount of such materials entering the marine food chain.

None of the base buildings proposed for renovation or demolition meets the designation as an historic structure. Portions of historic Fort Kamehameha are located within and immediately adjacent to the HIANG area on Hickam AFB. None of these historic facilities would be directly affected by construction activity. In compliance with Section 106 of the National Historic

Preservation Act (NHPA), Hickam AFB has completed consultation with State Historic Preservation Division (SHPD) regarding the Proposed Action. SHPD has concurred that the Proposed Action has no adverse affect to historic resources. HIANG has contacted the Office of Hawaiian Affairs regarding the Proposed Action. If a human burial were to be encountered during project construction, it would be managed in compliance with the Memorandum of Agreement (Burial Treatment Plan) among the Air Force, the Office of the Hawaiian Affairs, Hui Malama I Na Kupuna `O Hawai`i Nei, and the Oahu Island Burial Council. Therefore, impacts to traditional resources would be expected to be negligible. On-base renovation and construction is consistent with the Base General Plan.

The Proposed Action would generate an estimated 700 construction jobs and $37.0 million in direct earnings. The Honolulu City and County area have an adequate workforce to supply needed construction workers. The replacement of F-15 with F-22A aircraft would not noticeably change personnel levels from those currently supporting the F-15 squadron at Hickam AFB. The relatively small effects of HIANG aircraft replacement would not have a disproportionate impact on minority or low-income populations within the City or County of Honolulu. There would be no expected significant impact upon children.

Construction within the HIANG area would occur within the 100-year return flood hazard zone. Because nearly the entire installation is located within this zone, there are no practicable alternatives to construction of new facilities within the HIANG lease area at Hickam AFB. It would not be practicable to relocate the entire HIANG installation from its current site. The HIANG, in coordination with the Hawaii Coastal Zone Management Program, Office of Planning, will execute a consistency determination process to ensure Coastal Zone Management concurrence. It is anticipated that the Proposed Action will qualify for a Negative Determination due to the types and locations of proposed facilities, and because no activities will occur within the shoreline setback area. Construction activities will be monitored by a qualified professional archaeologist (Base Historic Preservation Office [BHPO]) during earthmoving activities near these sites. If archaeological resources are encountered, work would stop at that location and the discovery would be reported to the security forces and the BHPO.

FINDING OF NO PRACTICABLE ALTERNATIVE: Pursuant to Executive Order (EO) 11988, *Floodplain Management*; the authority delegated in HQ USAF/A7C Memorandum on Re-delegation of Environmental Authorities for Air Force Installations of 9 December 2004; and taking the above information into consideration, I find that there is no practicable alternative to this action and that the action includes all practicable measures to minimize harm to the existing environment. The HIANG Environmental Management Office (EMO) provided a 30-day public review period and sent notices to appropriate government organizations including the Hawaii

Coastal Zone Management Program Office and the Honolulu district of the United States Army Corps of Engineers (USACE).

FINDING OF NO SIGNIFICANT IMPACT (FONSI): Based on my review of the facts and analysis in the Environmental Assessment, I conclude that the Proposed Action will not have a significant impact either by itself or considering cumulative impacts. Accordingly, the requirements of the National Environmental Policy Act (NEPA), the Council on Environmental Quality (CEQ), and 32 CFR 989, et seq. have been fulfilled, and an Environmental Impact Statement (EIS) is not necessary and will not be prepared.

PETER S. PAWLING
Brigadier General, USAF
Commander, 154th Wing
Hickam Air Force Base, Hawaii

31 AUG 07
Date

WILLIAM M. CORSON
Colonel, USAF
Director, Installations and Mission Support
Pacific Air Forces

5 Sep 07
Date

REPLACEMENT OF F-15 AIRCRAFT WITH F-22A AIRCRAFT ENVIRONMENTAL ASSESSMENT

Hickam Air Force Base, Hawaii

September 2007

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TABLES

FIGURES

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EXECUTIVE SUMMARY

One of the primary missions of the United States Air Force (Air Force) is defense of the United States (U.S.) and fulfillment of the directives of the President and Secretary of Defense. The Hawaii Air National Guard (HIANG) has the responsibility to support national defense missions and requirements of the State of Hawaii. The HIANG has a major role with active Air Force units in the Global War on Terror, including deployment with the active Air Force units and air defense of the Hawaiian Islands. The HIANG has fielded operational F-15 air superiority aircraft based at Hickam Air Force Base (AFB), Hawaii, for over two decades. HIANG personnel must be fully integrated into the missions, tactics, and maintenance of the Air Force's most technologically advanced weapon systems to fully accomplish their role in the future. The F-22A is the Air Force's most technologically advanced weapon system for defense missions in the 21st century.

Proposed Action

The Air Force and Air National Guard (ANG) propose to replace the HIANG F-15 aircraft with F-22A aircraft at Hickam AFB beginning in Fiscal Year (FY) 2011. The proposal is to replace the 15 Primary Aircraft Inventory (PAI) F-15s, 2 Backup Aircraft Inventory (BAI) F-15s, and 3 Reserve Aircraft Inventory F-15s (20 total aircraft) with 18 PAI F-22As and 2 BAI F-22As (20 total aircraft).

Hickam AFB was identified as the location for the replacement of an ANG F-15 squadron because Hickam AFB meets three categories for siting criteria used to identify a suitable location:

- The first siting category is the set of operational siting criteria used to identify candidate F-22A basing alternatives since 2001. These criteria are an Air Force base with (1) an existing F-15 mission, (2) established support for fighter aircraft, (3) access to adequate training airspace, (4) support for varied training opportunities, and (5) available infrastructure and communication links.
- The second siting category is derived from the need to integrate ANG experience and capabilities with the active Air Force as part of the national mission in the ongoing Global War on Terror.
- The third siting category is the need to locate advanced U.S. weapon systems where they can rapidly respond to existing and projected national threats.

Four locations on the Pacific Rim were considered for beddown of this operational F-22A squadron. After comparing Eielson AFB, Alaska; Elmendorf AFB, Alaska; Andersen AFB, Guam; and Hickam AFB, Hawaii, with the selection criteria, Hickam AFB meets the original F-22A beddown selection criteria, meets national needs for advanced location, and has the ability at this time to accommodate operational F-22A aircraft. Hickam AFB is well-positioned to support the missions of the F-22A because Hickam AFB has air superiority F-15s, fighter-oriented command and control systems, training airspace suited to F-22A aircraft, and required fighter infrastructure and administrative capabilities.

The replacement F-22A aircraft would occupy the same HIANG location on the southern part of Hickam AFB currently occupied by the comparably-sized F-15 aircraft. The F-22A squadron would need demolition, renovation, and/or construction of an estimated 20 facilities to support the F-22A aircraft. Renovation and construction would be projected to occur over a 5-year period at a cost of approximately $146.4 million in Military Construction (MILCON) and Operations and Maintenance (O&M) FY 2007 dollars. Additional PAI F-22A aircraft and the projected improved maintenance capabilities of the F-22A mean that the F-22A would fly approximately 50 percent more missions from Hickam AFB than are currently flown by the F-15.

The F-22A aircraft would train in the same offshore military training airspace currently used for F-15 training and would deploy chaff and flare defensive countermeasures as the F-15 currently does during training. Both the F-15 and F-22A train using supersonic speeds. The F-15 flies supersonic approximately 7.5 percent of its mission, and the F-22A flies supersonic approximately 25 percent of its mission. The F-15 flies 8 percent of the time at altitudes above 30,000 feet; the F-22A flies 30 percent of its time above 30,000 feet. The F-15 is designed to perform an air superiority mission. The F-22A is designed to exceed that air superiority mission and to be capable of a low-observability air-to-ground stand-off mission with satellite-guided munitions. Most F-22A training would occur at high altitudes with simulated air-to-air and air-to-ground attacks. F-22A live-fire training would occur at ranges authorized for such training. This would include capability to perform live air-to-air munition training within airspace associated with the Pacific Missile Range Facility. The F-22A would not use Hawaiian military training routes (MTRs) or air-to-ground training ranges for low-level or air-to-ground training. F-15 instrument/arrival procedural training on an incidental basis occurs at Kaneohe, Barking Sands, Kona, and Lihue. The F-22A would perform comparable instrument/arrival procedural training and train for emergency procedures at the same outlying airfields as currently conducted by the F-15s.

The F-22A provides superior performance to the F-15 and presents advanced combat capabilities that permit air dominance over any battlefield. The F-22A enhanced capabilities include the following:

- State-of-the-art low-observability and radar-absorbent composite materials.
- Ability to sustain supersonic speed without the use of afterburners.
- Increased maneuverability during combat using directed engine thrust.
- Highly sophisticated avionic systems that are integrated throughout the F-22A to provide the pilot and other friendly aircraft with an unprecedented picture of the combat situation.
- Maintainability, sustainability, reliability, and responsiveness to provide for system self-test and reduced maintenance.

The Hickam AFB-based F-22A operational squadron would provide the HIANG with the most advanced weapons system and be positioned to rapidly respond to directives of the President and Secretary of Defense. The Hickam AFB F-22A squadron and the F-22A operational wing at Elmendorf AFB, Alaska, would provide a western complement to the eastern U.S.-based first F-22A Operational Wing at Langley AFB, Virginia. The replacement of F-15 aircraft with F-22A aircraft at Hickam AFB provides ANG and the Air Force with the capability to meet its 21st-century mission responsibilities.

No Action Alternative

No Action at Hickam AFB means no replacement of the F-15 squadron with an F-22A squadron at this time. No Action could affect future mission capabilities of the Pacific Air Forces (PACAF). No Action is equivalent to baseline conditions at Hickam AFB, which include the HIANG operational F-15 squadron and F-15 aircraft training in the offshore Warning Areas and Air Traffic Control Assigned Airspaces (ATCAAs) north and south of Oahu.

Environmental Consequences

The proposed replacement of F-15 aircraft with F-22A aircraft has the potential to affect certain environmental resources. Potentially affected resources have been identified through public scoping meetings, communications with state and federal agencies, and review of past environmental documentation. In addition, letters were sent to Native Hawaiian groups soliciting input. Specific environmental resources with the potential for environmental consequences include airspace management and air traffic control (including airport traffic), noise, safety, air quality, physical (including water) resources, biological resources, cultural resources, land use (including recreation and transportation), socioeconomics, and environmental justice. The results of the analysis of these environmental resources are summarized below.

Airspace Management and Air Traffic Control

Hickam AFB is a joint use facility with Honolulu International Airport. The airport supports approximately 880 daily flights, of which approximately 5 to 6 percent are military flights. Military average daily operations, including based and transient aircraft, would increase from 53 with the F-15 to 65 with the establishment of the F-22A squadron. This change in airspace management for the airfield would not be expected to significantly affect either the airspace or air traffic control. The HIANG has proposed to the Federal Aviation Administration (FAA) changes in approach patterns to reduce the potential for noise consequences. The HIANG will continue to coordinate with the FAA to modify current F-15 approach procedures in anticipation of proposed F-22A operations.

F-15 existing training and proposed F-22A training within Hawaiian airspace would occur approximately 75 percent of the time in three offshore training areas north of Oahu. The remaining 25 percent of the training time occurs in offshore Warning Areas south of Oahu. Use of these Warning Areas for training would have no effect on airspace management or air traffic control.

The No Action Alternative would have no change from the existing F-15 use of Hickam AFB and offshore military training airspace.

Noise

F-22A engines are more powerful and louder than F-15 engines. The power of the F-22A engine permits the F-22A take-off predominantly without the additional thrust of afterburners. In contrast, most F-15 launches are performed with afterburners. This results in very similar noise profiles during launch for the two aircraft. During landing, the louder F-22A engine would be noticeable on a long, straight-in approach to the runway. The HIANG proposes to adjust approach patterns to reduce the amount of off-base noise exposure associated with the louder F-22A engine. Noise in the environs of Hickam AFB and Honolulu International Airport is dominated by commercial traffic, which represents 94 to 95 percent of the daily aircraft operations. HIANG coordination is underway with the FAA to incorporate noise avoidance approach patterns for approximately 85 percent of the F-22A arrivals. An evaluation of noise effects using these approach patterns with nationally recognized and approved noise models results in no discernible change in off-base noise associated with the replacement of F-15s with F-22As. The more powerful F-22A engines would increase noise exposure on base and nearby military properties. Live-aboard boats within the Keehi Boat Harbor are currently subject to noise levels of Day-Night Average Sound Level (L_{dn}) 75 to 80 (Mestre Grove Associates 2004). The replacement of F-15 aircraft with F-22A aircraft would not be expected to change these noise levels. Incidental F-22A instrument/arrival procedure training at other airfields in the Hawaiian Islands would be comparable to such procedural training currently conducted by the F-15s. No measurable change in noise levels at these locations would be expected.

In the overwater airspace, there would be an increased number of sonic booms. The altitude of F-22A training, which in general is higher than that for the existing F-15s, would result in many of these sonic booms being detected as distant thunder. The air-to-water interface attenuates booms and rapidly reduces their intensity to the underwater environment.

The No Action Alternative would result in no change from the F-15 airfield operations and no change from the current F-15 subsonic and supersonic training in offshore Warning Areas.

Safety

New and improved HIANG facilities would permit incorporation of current safety technology. This includes safety setback locations and improved maintenance facilities. The F-22A carries the same munitions internally as the F-15 does externally. An internal explosion is calculated to spread more materials, including parts of the aircraft, over a larger area. The F-22A QD arc (758 foot radius) is larger than the F-15 QD arc (400 foot radius). The 154 WG will submit a required updated Explosive Site Plan for Hickam in accordance with AFI 91-201. Chapter 4 of this updated plan will account for this QD increase and its relationship to surrounding work areas.

F-22A aircraft would fly 50 percent more sorties but would more quickly leave the airfield area where bird aircraft strikes are more likely to occur. This is projected to have no noticeable change in bird aircraft strike hazards risk. To meet air defense requirements and training, the F-22A would fly with live munitions comparable to those used by the F-15s. The F-22A would use an estimated 2,318 fewer bundles of chaff and 784 fewer flares than are currently used by the F-15 aircraft. The F-15 Class A mishap rate per 100,000 flying hours is 2.46. During development, F-22A aircraft have lost one aircraft. F-22As have not flown the requisite 100,000 hours to be able to calculate a meaningful Class A accident rate. Any new, complex weapons system is likely to have a number of Class A accidents during testing and initial systems beddown.

Under the No Action Alternative, there would be no change from existing training by F-15 aircraft and continued use of chaff and flares in the training airspace.

Air Quality

The Honolulu area is in air quality attainment for all criteria pollutants. Temporary construction emissions could produce localized short-term, elevated emissions. Some construction and renovation would replace older equipment with new, lower emission equipment. Specific facilities, such as the proposed new facility for maintaining the low observability surfaces of the F-22A are expected to involve review of base air quality permits. Local air quality or visibility would not be significantly affected from construction or operations. No change is projected to air quality within the Honolulu area, and no conformity determination is required. There would be no effect to air quality or visibility in any Class I area as a result of F-22A training in the offshore airspace.

The No Action Alternative would mean no demolition or construction and would result in no change from current emissions.

Natural Resources - Physical Resources

On-base renovation and construction would occur at several previously disturbed locations within the HIANG area on Hickam AFB. National Pollution Discharge Elimination System (NPDES) stormwater permits and the site specific Stormwater Pollution Control Plan (SWPCP) (also referred to as Stormwater Pollution Prevention Plan [SWPPP]) would be updated with best management practices (BMPs). The F-22A is the first major Air Force weapon system to incorporate pollution prevention and the environment, safety, Hazardous Materials (minimization and disposal), and health considerations from the design throughout the weapon system lifecycle. No significant effects would occur to physical resources as a result of the Proposed Action. Effects to marine resources under the airspace would be comparable to those currently existing with F-15 training. The difference would be the deposition of six 2-inch x 4-inch Mylar pieces with deployment of each chaff bundle. The sizes of the airspace and the amount of chaff and flare use would result in 0.6 to 13 pieces of plastic or Mylar material being deposited annually per square mile of ocean under the airspace. Although this is more than the current 0.25 to 5.8 pieces per square mile with the F-15 training, no significant impact is expected from this change.

The No Action Alternative would not result in improvements to HIANG facilities and would continue to have the F-15 chaff and flares deployed within the military training airspace. F-15 training currently results in 0.25 to 5.8 pieces of plastic being deposited annually per square mile.

Natural Resources - Biological Resources

Demolition or construction of facilities would occur on previously disturbed HIANG areas. Construction and base aircraft operations would not be expected to impact sensitive biological resources. Noise contours on base would be larger than baseline conditions, although biological species associated with the base and its environs are habituated to aircraft noise and are not expected to be adversely affected. Sonic booms in the airspace would not be expected to transfer from the air to the water at sound levels that could result in harm or harassment to marine mammals or other marine species. Plastic or Mylar pieces of debris from chaff or flares are inert and are currently randomly distributed under the airspace. Although not significant, any deposition of plastic or Mylar materials in the northern Pacific Ocean could increase the amount of such materials entering the marine food chain.

The No Action Alternative would produce no change to biological resources from the current conditions at Hickam AFB or under the offshore airspace.

Cultural Resources

None of the base buildings proposed for renovation or demolition meets the designation as an historic structure. Portions of Fort Kamehameha are located within and immediately adjacent to the HIANG area on Hickam AFB. None of these facilities would be directly affected by construction activity. Renovation or demolition of buildings in the HIANG area would not change the historic nature of the Fort Kamehameha Historic District. Residences within the historic district could be subject to additional noise from F-22A operations. These residences are planned for compatible use at the projected noise levels by the time F-22A aircraft replace F-15 aircraft. No known Native Hawaiian traditional cultural sites or historic properties are projected to be impacted by HIANG construction or F-22A flight operations.

HIANG has contacted the Office of Hawaiian Affairs regarding the Proposed Action. If a human burial were to be encountered during project construction, it would be managed in compliance with the Memorandum of Agreement (Burial Treatment Plan) among the Air Force, the Office of the Hawaiian Affairs, Hui Malama I Na Kupuna `O Hawai`i Nei, and the Oahu Island Burial Council. Therefore, impacts to traditional resources would be expected to be negligible.

The No Action Alternative would result in no change from baseline conditions.

Land Use

On-base renovation and construction is consistent with the Base General Plan. Day/night average sound levels (L_{dn}) over base housing and other portions of the base are projected to increase. These noise levels would be consistent with those anticipated on a military installation. Noise contours off base are dominated by commercial aircraft and would not change with the F-22A approach pattern proposed by the HIANG. Some increased traffic congestion during construction could occur, including temporary weekday traffic disruptions during construction. Traffic would be expected to continue at current levels following the replacement of F-15 aircraft with F-22A aircraft. Land uses in the vicinity of the base are currently under approach patterns for the Honolulu International Airport and are not expected to be impacted by F-22A operations. Recreational areas near the HIANG and overwater recreational activities could experience short-term effects, but would not be significantly impacted by replacing the F-15 aircraft with F-22A aircraft.

The No Action Alternative would have no change from baseline conditions with a continued presence of military aircraft and military aircraft training.

Socioeconomics

The estimated 20 projects and approximately $146.4 million in construction and renovation costs would generate an estimated 700 construction jobs and $37.0 million in direct earnings. Socioeconomic consequences of renovation and construction are estimated to peak at $215 million in total output and 1,450 total jobs. The Honolulu City and County area have an adequate workforce to supply needed construction workers. The replacement of F-15 with F-22A aircraft would not noticeably change personnel levels from those currently supporting the F-15 squadron at Hickam AFB. The Honolulu urban economy would not have a noticeable change in economic activity as a result of the replacement of F-15s with F-22As.

The No Action Alternative would result in continued base personnel activity levels necessary to support Hickam AFB and HIANG missions.

Environmental Justice

Minority populations represent 82.5 percent of Honolulu City and low-income populations represent 13.0 percent of Honolulu City. These percentages are higher than the percentages of Honolulu County, which are 8.1 and 9.4 percent respectively. The relatively small effects of HIANG aircraft replacement would not have a disproportionate impact on minority or low-income populations within the City or County of Honolulu. The population of children is 18.4 percent in the City of Honolulu as compared with 23.8 percent in Honolulu County. There would be no expected significant impact upon children.

The No Action Alternative would result in no change from existing conditions.

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1.0 PURPOSE AND NEED FOR THE HAWAII AIR NATIONAL GUARD REPLACEMENT OF F-15 AIRCRAFT WITH F-22A AIRCRAFT

The Air National Guard (ANG) has taken a major role alongside the active United States Air Force (Air Force) in the Global War on Terror. As a consequence, ANG personnel must be fully integrated into the missions, tactics, and maintenance of the Air Force's most technologically advanced weapons systems. In Hawaii, this expertise has been demonstrated by the Hawaii Air National Guard (HIANG) at Hickam Air Force Base (AFB), which has maintained operational squadron of F-15 Eagle air-superiority aircraft for over two decades.

In 1985, the Air Force identified a need for a next-generation fighter to replace and supplement the aging F-15 fighters and to ensure air dominance well into the 21st century. Congress supported the F-22A Raptor as the aircraft to meet this need. The Air Force now proposes to replace one HIANG F-15 squadron at Hickam AFB with a squadron of operational F-22A Raptors.

The purpose of the proposed HIANG F-22A operational squadron is to have national security assets positioned to rapidly respond to the directives of the President and Secretary of Defense and to provide the Air Force with the capability to rapidly deploy to anywhere on the Pacific Rim. Hickam AFB has a HIANG F-15 squadron and thus has the organizational structure and infrastructure to support air superiority fighter aircraft. Additionally, the HIANG has operational air superiority experience, an air superiority mission, and extensive over-water training airspace to meet the needs for an F-22A operational squadron.

The proposal would replace 15 F-15 Primary Aircraft Inventory (PAI), 2 Backup Aircraft Inventory (BAI), and 3 Reserve Aircraft Inventory (20 aircraft) with 18 F-22A PAI and 2 F-22A BAI aircraft (20 aircraft). As part of the aircraft replacement, there would also be renovation of existing Hickam AFB facilities, construction of new facilities, changes in personnel assignments, and flight training operations in existing offshore airspace.

The Composite Hangar Facility currently for the F-15s is located at the HIANG at Hickam AFB.

This Environmental Assessment (EA) analyzes the potential environmental consequences associated with the replacement of F-15 aircraft with F-22A aircraft. This EA has been prepared in accordance with the National Environmental Policy Act (NEPA) (42 United States Code [USC] 4321-4347), the Council on Environmental Quality (CEQ) Regulations (40 Code of Federal Regulations [CFR] § 1500-1508), and 32 CFR Part 989, *et seq.*, *Environmental Impact Analysis Process* (Air Force Instruction [AFI] 32-7061). NEPA is the basic national requirement for identifying environmental consequences of federal decisions. NEPA ensures that environmental information is available to the public, agencies, and the decision-maker before decisions are made and before actions are taken. 32 CFR Part 989 addresses the implementation of NEPA and directs Air Force officials to consider the environmental consequences of any proposal as part of the decision-making process.

1.1 Purpose of F-22A Replacement of F-15 Aircraft at Hickam AFB

One of the primary missions of the Air Force is defense of the United States (U.S.) and fulfillment of the directives of the President and Secretary of Defense. To meet these requirements, the Air Force must develop and operate combat and support aircraft and train personnel. The ANG is an integral part of this Air Force overall mission.

The Air Force faces two challenges to providing air dominance with its current fleet of fighter aircraft. First, other nations are continuously improving their aerial warfare capability by fielding newer, faster, more maneuverable aircraft, such as the MiG-29, Su-35, Rafale, Gripen, and Typhoon. Second, potential adversaries have added sophisticated air defenses built around surface-to-air missiles and advanced radars that can target older aircraft such as the F-15 more accurately and at greater distances than in the past. The new F-22A has the low observability, speed, and maneuverability to overcome these new challenges and ensure air dominance over any battlefield.

Figure 1.1-1 depicts the F-22A development program over the last two decades.

Replacing the F-15 operational squadron with an F-22A operational squadron at Hickam AFB would provide a western location to allow the squadron to rapidly respond to directives of the President and Secretary of Defense. The eastern U.S.-based 1st Fighter Wing operates F-22As at Langley AFB, Virginia; F-22As are replacing F-117 low-observability aircraft at Holloman AFB, New Mexico; and in the west, two operational F-22A squadrons will be based at Elmendorf AFB, Alaska. With the proposed HIANG F-22A operational squadron at Hickam AFB, the Air Force will be provided with the capability to meet its mission responsibilities, which include rapid worldwide deployment, and the air defense of the Hawaiian Islands.

1.2 Need to Replace the HIANG F-15 with F-22A Aircraft

The intersection of three requirements, mentioned below, converge to create a need to replace the existing HIANG operational F-15 squadron at Hickam AFB with an operational squadron of F-22A aircraft. These requirements consist of (1) application of the existing F-22A operational beddown criteria to replace operational F-15 squadrons, (2) forward basing of the F-22A weapon system on the Pacific Rim to face current and projected threats, and (3) continued integration of the most advanced Air Force weapon system, the F-22A, into the ANG.

The Air Force is establishing operational F-22A aircraft squadrons that fulfill the F-22A's essential air dominance role in national defense. Because the ANG has taken on an increasing role in overall Air Force mission planning and execution, and the F-22A represents the future weapons system for Air Force air superiority missions, the ANG needs to develop expertise with the F-22A weapons system.

Each F-22A operational squadron must be combat-ready and able to perform its mission anywhere in the world at any time. The HIANG operational squadron must meet the original selection criteria evaluated for the location of the F-22A Initial Operational Wing (Air Force 2001); meet national needs for location with access to the Pacific Rim; and have the current capacity to beddown the F-22A operational squadron. The need to replace the existing HIANG operational F-15 squadron with the technologically advanced operational F-22A squadron is the logical outgrowth of the F-22A development program.

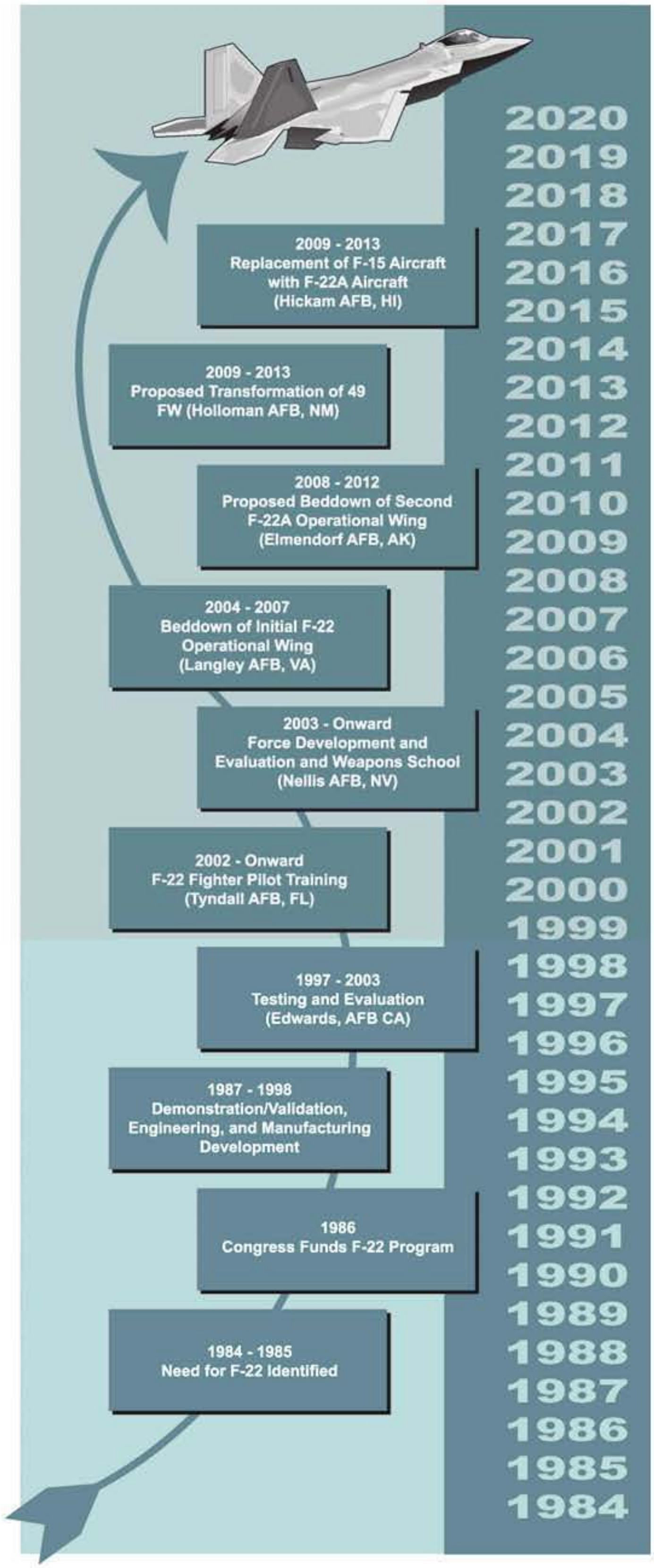


Figure 1.1-1. F-22A Development Program

In November 2001, the Air Force reviewed Air Force F-15 squadrons to identify bases that met the needs for beddown of the next generation F-22A operational aircraft (Air Force 2001). Four of six F-15 bases considered during that review are currently receiving F-22A training, test, or operational aircraft.

These bases include F-22A operational wings at Langley AFB, Virginia, and Elmendorf AFB, Alaska; weapons test and evaluation on F-22A aircraft at Nellis AFB, Nevada; and F-22A pilot training at Tyndall AFB, Florida, also considered for F-22A operational squadrons. During the Base Realignment and Closure (BRAC) process of 2005, the two remaining bases from those addressed in 2001 were selected as locations to concentrate Air Force F-15E assets (Mountain Home AFB, Idaho) and to perform multi-agency F-35 pilot training (Eglin AFB, Florida).

During 2005, the Quadrennial Defense Review (QDR) of U.S. defense capabilities identified two additional needs for F-22A operational aircraft. One was the need to substantially upgrade the low-visibility penetration mission currently performed by the older F-117 aircraft based at Holloman AFB. In July of 2006, the decision was made to replace the low-visibility penetration F-117 aircraft with the substantially greater capabilities of the low-visibility F-22A aircraft.

A second QDR need was closely tied to current and projected future operational requirements that integrate ANG units with active Air Force units in the Global War on Terror. Operational ANG personnel need to be experienced with the most up-to-date and technologically advanced weapons systems in the Air Force to ensure full integration into future combat requirements. This weapons system is the new F-22A. Thus, there is a requirement to replace an operational squadron of ANG F-15 aircraft with F-22A aircraft. Finally, current and projected strategic and tactical defense requirements prioritize the location of F-22A operational aircraft on the Pacific Rim.

The ultimate goal of the F-22A development and operational deployment process is to provide the Air Force with a proven, tested aircraft, as well as tactics and operational guidance to meet mission requirements. F-22A operational wings have been identified for Langley AFB, Elmendorf AFB, and Holloman AFB. F-22A weapons test and tactics and pilot training have been identified for Nellis AFB and Tyndall AFB. The proposed beddown of the ANG F-22A operational squadron at Hickam AFB, as analyzed in this EA, represents the next operational step in providing needed F-22A units to strategic locations.

1.3 Hickam AFB

Hickam AFB, located near Honolulu, Hawaii, is part of the Pacific Air Forces (PACAF). Hickam AFB is the home of the 15th Airlift Wing and 140 tenant and associated units, including the HIANG. The HIANG includes the 154th Wing (154 WG), 201st Combat Communications Group (201 CCG), and the 199th Weather Flight.

A variety of fighter squadrons have been based at Hickam AFB throughout its history. An F-15 approach is pictured here.

The 154 WG includes the 199th Fighter Squadron (199 FS), which is equipped with F-15 fighters. The 199th provides interceptor capability for Hawaii's air defense system and provides operationally ready combat units, combat support units, and qualified personnel for active duty in the Air Force in times of war, national emergency, or operational contingency. The HIANG also flies C-17 transports and KC-135R tankers. As depicted on the inset map of Figure 1.3-1, Hickam AFB shares a boundary and runways with the Honolulu International Airport. Hickam AFB covers 2,520 acres, with the HIANG leased area consisting of 128 acres.

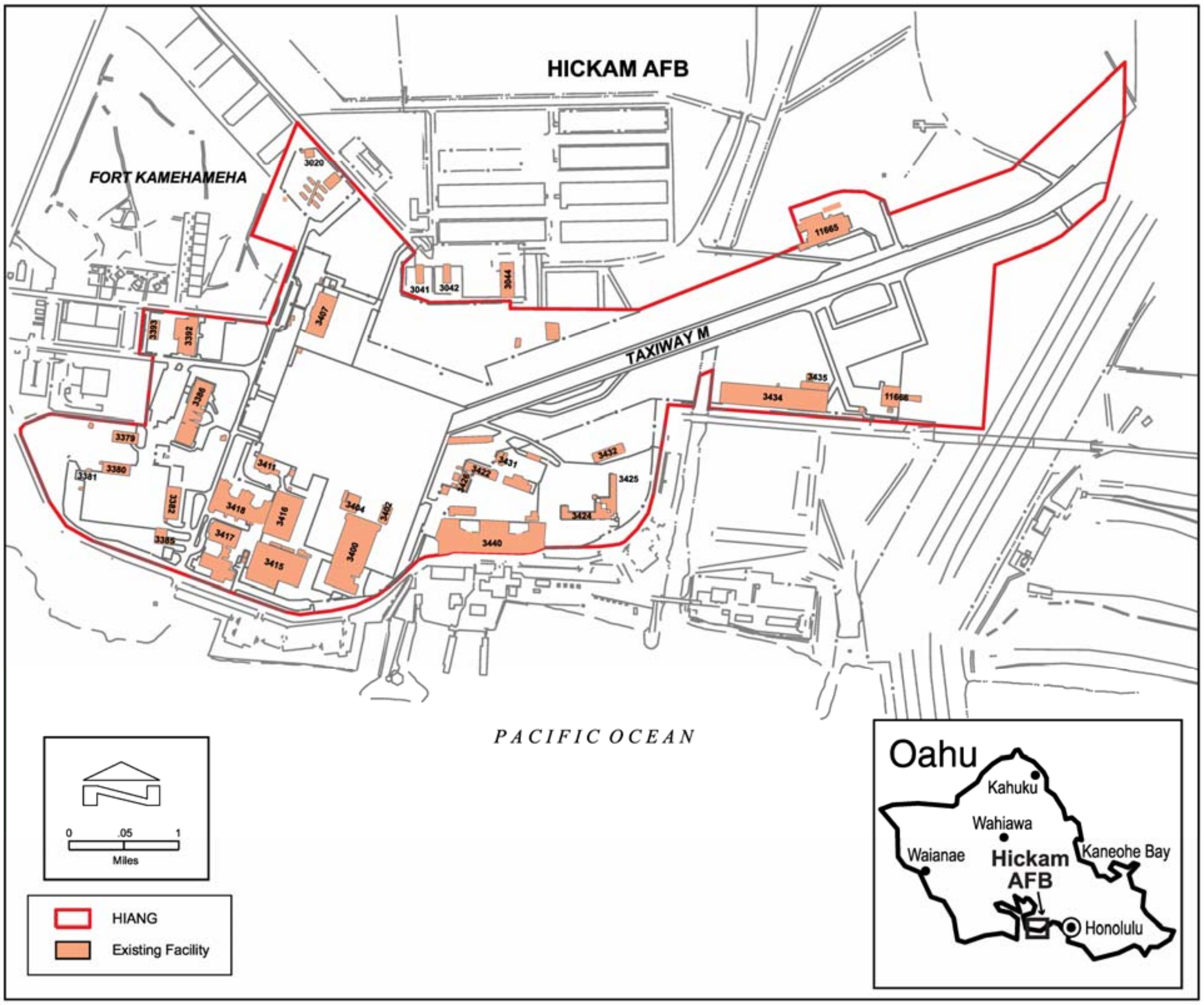


Figure 1.3-1. HIANG Tenant Area at Hickam AFB, Hawaii

The HIANG is a tenant on Hickam AFB. HIANG F-15 aircraft have one area on the base for all parking, maintenance, and other support services as presented in Figure 1.3-1. Under the Proposed Action, renovation and new construction would be needed to meet requirements for the F-22A operational squadron. This construction would be within or adjacent to the existing HIANG area. The runways associated with Hickam AFB are joint use for military Honolulu International Airport and commercial traffic. There are four runways at HNL of lengths of 12,300 feet (8L-26R), 12,000 feet (8R-26L), 9,000 feet (4R-22L), and 6,700 feet (4L-22R). There are barrier arresting systems on Runways 8L, 4R, and 8R. The F-22A would not be expected to use the arresting barriers any differently than they are currently used for the F-15. No runway modifications are proposed for the F-15 to the F-22A replacement.

Throughout its history, Hickam AFB has based and/or supported large numbers of aircraft participating in World War II, Korean War (F-86 aircraft are pictured), Vietnam War, Cold War, Gulf War, and Global War on Terror.

Hickam AFB fighter aircraft train in extensive offshore training airspace (Figure 1.3-2). Offshore airspace permits supersonic flight and allows the use of chaff and flares for F-15 defensive training. The HIANG would train with the F-22As in existing warning areas currently used for F-15 training. No airspace modifications are proposed for HIANG F-22A training.

1.4 Aircraft Characteristics

The Proposed Action is to replace the existing F-15 Eagle with the pictured next-generation F-22A Raptors at Hickam AFB.

The F-22A Raptor is designed to ensure that America's armed forces retain air dominance. This means complete control of the airspace over an area of conflict, thereby allowing freedom to attack and freedom from attack at all times and places for the full spectrum of military operations. Air dominance provides the ability to defend American and Allied forces from enemy attack and to attack air and ground adversary forces without hindrance from enemy aircraft. During the initial phases of deployment into an area of conflict, the first aircraft to arrive are the most vulnerable because they face the entire warfighting capability of an adversary. The F-22A's state-of-the-art technology, advanced tactics, and skilled aircrew will ensure air dominance from the outset of such encounters. The F-22A has the low observability, speed, sensors, weapons, and maneuverability to overcome adversary improvements in air defenses and ensure air dominance over any battlefield for the foreseeable future.

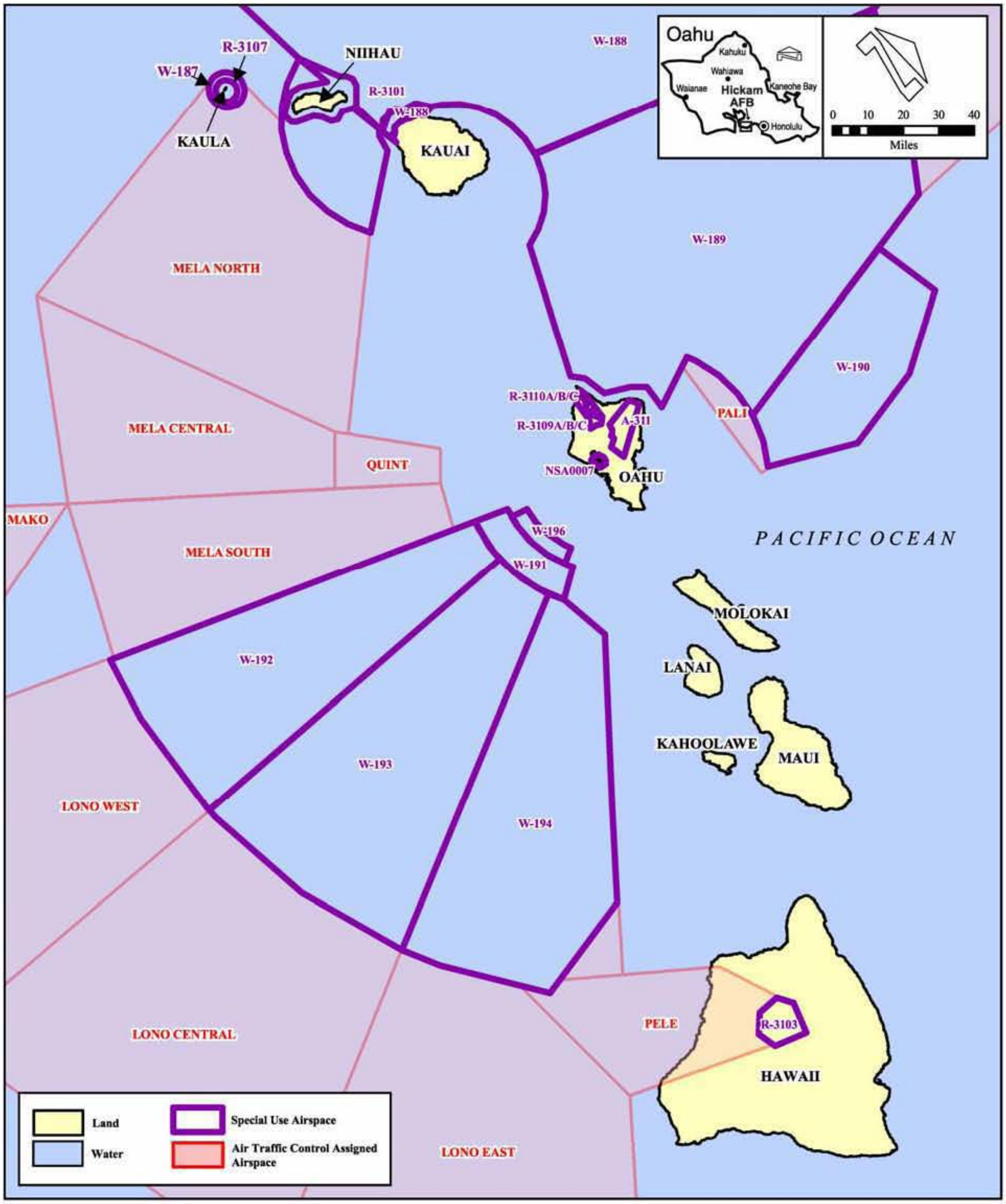


Figure 1.3-2. Baseline and Proposed Warning Areas and ATCAAs used for HIANG Training

The F-22A aircraft is a 21st century fighter designed to replace and supplement F-15 aircraft, which can be targeted by enemy air defenses at increasingly greater distances. The HIANG, as an integral part of the Air Force, is to be equipped, trained, and ready to fulfill its combat missions as directed by the President and Secretary of Defense.

1.4.1 Aircraft Characteristics of the F-15

The F-15 is armed with the AIM-7M Sparrow or AIM-120 Advanced Medium-Range Air-to-Air Missiles, the AIM-9M sidewinder, and a 20-millimeter cannon.

The F-15 Eagle, an air superiority fighter, was developed in 1965 and attained initial operational capability in 1976. The aircraft was developed to arrive early during a battle and control access to the battle from the sky. These missions were to be performed frequently for short durations, with rapid airfield maintenance and quick turnaround times. During Desert Storm, the F-15 aircraft flew long missions, refueled in flight, escorted Coalition aircraft and provided air superiority by defeating enemy aircraft. While the F-15 has a superb combat record, it is an aging aircraft at a time when other nations are fielding more advanced fighters. The F-15 routinely operates at medium altitudes (20,000 to 30,000 feet above mean sea level [MSL]). Powered by two engines that each provides 18,000 pounds of thrust, the F-15 can achieve speeds for a short period in the 1,600 miles-per-hour range. The F-15 uses power settings ranging from above 90 percent to afterburner use; afterburners greatly increase fuel consumption to achieve supersonic speeds. Each F-15 is 64 feet long, with a wingspan of 43 feet, and is slightly over 18 feet in height.

1.4.2 Aircraft Characteristics of the F-22A

The F-22A is designed to replace and supplement the F-15 fleet. The F-22A offers a unique combination of capabilities that make it less detectable, faster, more fuel efficient at supersonic speeds, more maneuverable, and more reliable than the F-15. It also has unparalleled communication and radar capabilities. These capabilities enable the F-22A to reach the conflict faster, reduce risk to pilots, and provide more air power to the combat commander. F-22A enhanced capabilities include the following:

- **Low Observability**: State-of-the-art design and radar-absorbent composite materials make the F-22A much harder to detect by radar than conventional aircraft of similar size.
- **Supersonic Speed**: The F-22A can sustain supersonic speeds without the use of afterburners. This capability permits the F-22A to operate longer at higher speeds and with less vulnerability.
- **Increased Maneuverability**: The F-22A design, coupled with the ability to direct engine thrust, permits the pilot to turn more rapidly, maintain better control, and evade missile threats better than other fighter aircraft.
- **Advanced Electronics:** Highly sophisticated avionics systems are integrated throughout the F-22A to provide the pilot information from many sources and produce a clear, understandable picture of the combat situation. This understanding can be transmitted to allied aircraft to multiply force effectiveness.

- **Maintainability, Sustainability, Reliability, and Responsiveness:** Reliability and mission-readiness of the F-22A is enhanced with computerized self-tests of all systems and other maintenance features. The F-22A requires fewer personnel and equipment for maintenance and deployment compared to the F-15.


The F-22A has enhanced low observability, speed, maneuverability, electronics, and maintainability.

The F-22A Raptor is a single-seat, all-weather, multipurpose fighter capable of both air-to-air and air-to-ground missions. Powered by two 35,000-pound thrust-class engines, the F-22A routinely operates at higher altitudes (above 30,000 feet MSL) and higher speeds than the F-15. Its thrust-to-weight ratio permits the F-22A to quickly achieve and sustain speeds needed for air-to-air combat. The F-22A is approximately 62 feet long, with a wingspan of 44 feet, and a height of more than 16 feet.

The F-15 and F-22A are similar in size and shape. Figure 1.4-1 shows some features that distinguish one aircraft from the other. The F-22A can carry six radar-guided AIM-120 Advanced Medium-Range Air-to-Air Missiles, heat-seeking AIM-9 Sidewinder short-range missiles, and has a 20-millimeter multi-barrel gun for air-to-air engagements. The F-22A has the capability to carry a variety of conventional and Long Range Stand-Off Weapons (LRSOW) for air-to-ground ordnance delivery. When performing air-to-ground missions, the F-22A can internally carry two Global Positioning System-aided 1,000-pound Joint Direct Attack Munitions (JDAM). Alternatively, the F-22A has the capacity to carry several Small Diameter Bombs internally and to attack multiple targets.

Training in Hawaii over-water airspace would simulate, but would not release live or training air-to-ground munitions. Air-to-ground for LRSOW training would include flying to launch profiles and speeds at training altitude with simulated launches where no munitions would be released. Training with actual release of air-to-ground munitions would occur when HIANG F-22A aircraft were deployed to existing ranges that permitted such munitions training.

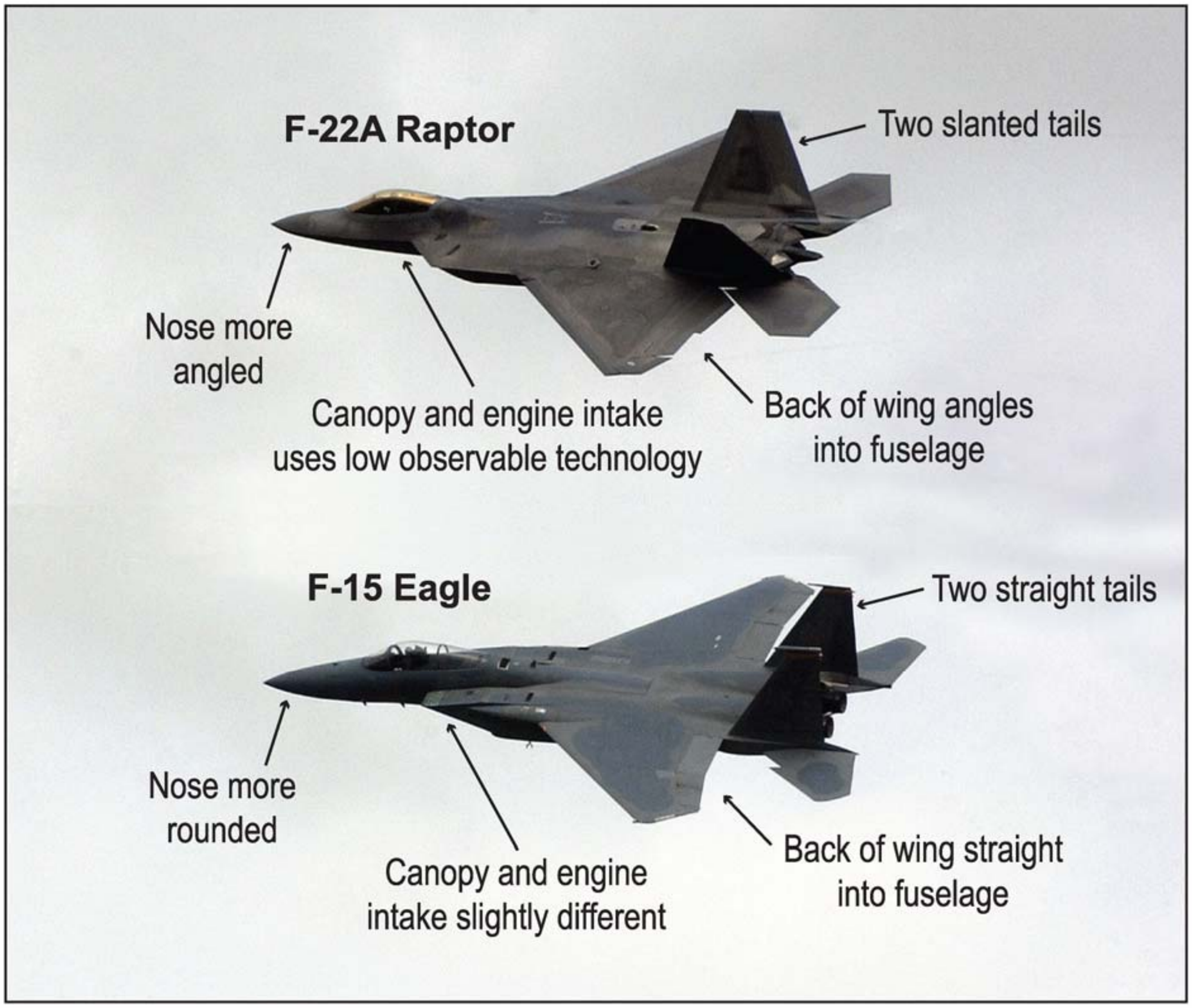


Figure 1.4-1. F-22A and F-15 Aircraft Characteristics Comparison

2.0 DESCRIPTION OF THE PROPOSED ACTION AND NO ACTION ALTERNATIVE

The Proposed Action is to replace the 199 FS operational F-15 aircraft at Hickam AFB with F-22A operational aircraft. This action would provide an ANG operational squadron with the most advanced fighter aircraft in the Air Force. This chapter describes the Proposed Action and associated beddown facilities. The No Action Alternative, which would not beddown the F-22A at Hickam AFB at this time, is also discussed.

Establishment of an operational HIANG F-22A squadron at Hickam AFB is proposed to take place over a period of approximately 5 years. It would involve renovation and construction of facilities to support the aircraft, as well as the training of personnel who would operate and maintain the aircraft and associated facilities.

Primary Aircraft Inventory (PAI) are aircraft assigned to meet the Primary Aircraft Authorization (PAA). Backup Aircraft Inventory (BAI) are aircraft above the PAI to permit scheduled and unscheduled depot level maintenance, modifications, inspections and repairs, and certain other mitigating circumstances without reduction of aircraft available for the assigned mission. BAI may also be referred to as Backup Aircraft Authorization (BAA).

The F-22A squadron proposed for Hickam AFB would be composed of 18 PAI and 2 BAI aircraft. PAI consists of the aircraft authorized and assigned to perform the squadron's missions in training, deployment, and combat. BAI includes those aircraft additional to the PAI that are used as substitutes for PAI aircraft.

Activities Affecting Hickam AFB

- Beddown one F-22A operational squadron over a period of approximately 5 years.
- Conduct flying sorties at the base for training and deployment.
- Renovate/construct the facilities and infrastructure necessary to support the F-22A Operational squadron.
- Implement changes in personnel assignments to conform to the F-22A squadron's requirements.

Elements Affecting Hawaii Offshore Airspace

- Conduct F-22A training flights in offshore warning areas.
- Employ defensive countermeasures (chaff and flares) during training within the airspace.
- Train for employment of Long Range Stand-Off Weapons and other munitions.

The beddown of the Hickam AFB F-22A operational squadron is proposed to take place in the following stages:

- Renovation and construction of facilities in Fiscal Years (FY) 2009-2013
- Beddown of F-22A operational squadron in FY 2011-2012

To achieve and maintain combat proficiency, F-22A pilots need both air-to-air and air-to-ground training. Hickam AFB has adequate training airspace and does not propose any airspace changes. LRSOW and other air-to-ground munitions training can be adequately simulated in existing airspace.

This chapter presents an overview of the construction area and a list of facilities proposed for renovation within the existing ANG area on Hickam AFB. This chapter also describes proposed activities at the base, training use of offshore Warning Areas, and the personnel associated with an F-22A operational squadron. The No Action Alternative is described in conformance with the CEQ regulations (40 CFR 1502.14[d]) in Section 2.2.4. Alternatives considered but not carried forward for analysis are discussed in Section 2.3.

2.1 Identification of Alternatives

The identification of alternatives for locating this F-22A operational squadron followed a step-wise application of identified selection criteria. Initial selection criteria from the alternative location identification process contained in the Initial F-22 Operational Wing Beddown Final Environmental Impact Statement (EIS) (Air Force 2001) were combined with recent and projected future Air Force and national defense requirements. This section explains the siting criteria, application of the siting criteria to identify candidate basing locations, and refinement of the application to identify the proposed action and any viable alternatives for beddown of this squadron.

> Siting Criteria drew from the initial Operational wing beddown, current and projected threats, and the increasing role of HIANG units.

2.1.1 Identification of Siting Criteria

Three categories of siting criteria were used to identify the proposed action for this EA.

- The first siting category is the operational siting criteria used to identify candidate basing alternatives since 2001.
- The second siting criterion results from recent experience and specifies that, to the extent possible, the U.S. needs to locate advanced weapon systems where they can rapidly respond to existing and projected national threats.
- The third criterion is derived from the experience of the Air Force and ANG in the ongoing Global War on Terror.

The siting criteria used to identify candidate alternatives for both the first and second F-22A operational wings are summarized in Table 2.1-1. These siting criteria were used in the Initial F-22 Operational Wing Beddown EIS (Air Force 2001) for Langley AFB and the EA for the FY 2009 F-22A beddown of 36 F-22A aircraft at Elmendorf AFB, Alaska (Air Force 2006a). This resulted in two squadrons of F-22A aircraft located at Langley AFB and Elmendorf AFB.

Operational F-22A squadrons need to be located where they can rapidly meet national defense objectives. Locating F-22A operational squadrons on the Pacific Rim places advanced assets where they can achieve rapid worldwide deployment in response to directives of the President and Secretary of Defense. Four locations on the Pacific Rim were considered for beddown of this operational F-22A squadron. Each of the four Pacific Rim candidate locations was compared with the operational criteria identified in Table 2.1-1. The result of this application of siting criteria is presented in Table 2.1-2.

The ANG is an integral part of the Air Force. Placing an F-22A operational squadron as part of ANG capabilities would enhance national defense capabilities. Identification of the HIANG as the proposed location for the first ANG operational F-22A squadron meets all three siting criteria categories.

Table 2.1-1. Summary of Selection Criteria to Beddown an F-22A Operational Squadron

Criteria	*Explanation*
1. Air Force Base with an Existing F-15 Mission	F-22A operational aircraft must be established at an Air Force base to maintain positive command and control and to ensure mission priority. Beddown of the F-22A at an F-15 base would result in the least disruption in operations and combat capability. In addition, the organizational structure, training regimes, mission planning capabilities, and support functions (e.g., weapons handling, security) at an F-15 base would already match those needed for F-22A operational aircraft.
2. Established Support for Fighter Aircraft	Operational fighter aircraft need a base already conformed and organized to support fighter aircraft. Requirements (e.g., infrastructure, organization) for fighter aircraft differ markedly from those for bombers, tankers, and transports. Fighter aircraft commonly generate more sorties but have shorter duration missions. Maintenance and support crew organization and logistics must fit the tempo and nature of fighter operations.
3. Access to Airspace for Training	The base must have access to existing airspace of sufficient size and vertical dimensions to accommodate the breadth of training required for the air superiority mission, including multi-aircraft, air-to-air combat engagements, and supersonic flight. The airspace must be located within sufficient proximity to the base to support unrefueled F-22A training.
4. Support Varied Training Opportunities	Varied training must provide aircrews with the opportunity to encounter the wide range of situations that mirror combat as closely as possible. Such training requires the F-22A pilots to face and defeat threats from the air and the ground. Realism and quality in such situations involve a range of training activities including multi-aircraft engagements, identifying and targeting adversaries from long distances, and using the full capabilities of the F-22A. The ability to use chaff and flares as defensive countermeasures to defeat both air and ground threats forms an important quality of the airspace.
5. Available Infrastructure	To maximize the efficiency of the F-22A aircraft and to offer the ability to integrate the F-22A mission immediately, the base must provide adequate infrastructure. The existing infrastructure (e.g., fueling, runways) of a base must be designed and oriented around a fighter mission.
6. Existing Communications Links	Any base considered suitable for the beddown must have the existing communication capability to accommodate the requirements of an air dominance wing.

Source: Air Force 2001

Table 2.1-2. Application of Siting Criteria (Page 1 of 2)

Criteria	Air Force Base			
	Andersen	*Eielson*	*Elmendorf*	*Hickam*
Air Force Base with an existing F-15 mission	An advanced location with extensive staging responsibilities. Primarily organized to support large aircraft. Does not have an existing F-15 mission.	An advanced location but does not have an existing F-15 mission.	Selected as the location for the second F-22A operational wing. Following F-22A beddown, will continue to maintain F-15 aircraft. Replacing these remaining F-15 aircraft with F-22A aircraft would concentrate three operational squadrons in one advanced location. Not a preferred alternative at this time.	An advanced base with an F-15 air superiority mission.
Established support for fighter aircraft	Not an installation with existing fighter aircraft support. Supports multiple aircraft types as a staging area for deployment on the Pacific Rim.	Past support capabilities for combined air-to-air and air-to-ground capable F-16 aircraft. F-16 air-to-air squadron proposed to remain following BRAC 2005. A-10 aircraft proposed for reassignment as part of BRAC 2005.	Extensive support for fighter aircraft with existing F-15Cs and F-22A squadrons scheduled for beddown.	Contains a specific on-base area for exclusive support of ANG F-15 fighter aircraft. Other parts of base support multiple aircraft types including aircraft deployed into other areas of the Pacific Rim.
Access to training airspace	Has access to existing airspace sized to support F-22A operational training. Weather conditions not expected to affect operational training.	Has access to existing airspace sized to support F-22A operational training. Weather conditions could place limitations on training during certain seasons.	Has access to existing airspace sized to support F-22A operational training. Weather conditions could place limitations on training during certain seasons.	Has access to existing airspace sized to support F-22A operational training. Weather conditions not expected to affect operational training.

Table 2.1-2. Application of Siting Criteria (Page 2 of 2)

Criteria	Air Force Base			
	Andersen	*Eielson*	*Elmendorf*	*Hickam*
Support varied training opportunities	Navy-managed airspace primarily in over-water Warning Areas. Some limitations to operational training due to schedule for deployed aircraft taking precedence. Terrain variability limited.	Air Force-scheduled airspace supports varied terrain for air-to-air and air-to-ground missions. Munitions training limited to deployed conditions.	Air Force-managed airspace supports varied terrain for air-to-air and air-to-ground missions. Munitions training limited to deployed conditions.	Navy-managed over-water airspace with northern Warning Area primarily assigned to the Air Force. Few conflicting airspace demands between HIANG fighters and any other aircraft. Terrain variability limited.
Available Infrastructure	Limited infrastructure due to size of base and multiple heavy aircraft support missions. Extensive additional infrastructure would be needed to support F-22A mission.	Potential reassignment of A-10 aircraft will free up infrastructure for additional capabilities. Based on Elmendorf experience, extensive new facilities would be required for F-22A beddown in Eielson.	Replacement of F-15 squadrons with F-22A squadrons and construction of new F-22A facilities will allocate available infrastructure to the new F-22A mission. Little additional available infrastructure.	Replacement of F-15 by F-22A aircraft would utilize existing facilities. Some new facilities required to meet special F-22A mission requirements.
Existing Communication Links	Communication linkages throughout over-water airspace. Communication would place large aircraft as primary mission over fighter aircraft.	Extensive communications linkages. Some terrain restrictions on communication affect low-level training but not expected to interfere with F-22A operational training.	Extensive communications linkages. Some terrain restrictions on communication affect low-level training but not expected to interfere with F-22A operational training.	Communication linkages throughout over-water airspace. Communications enhanced by mountain locations.

2.1.2 Review of Candidate Basing Locations

The four candidate basing locations were screened using the three categories of operational criteria, including siting criteria, applied to operational F-22A beddown for the first and second F-22A operational wings. The results of this screening are summarized below:

1. **Andersen AFB.** Good training conditions in Guam when scheduling permits. Primarily a support base for large aircraft and supply transport. Not an F-15 base with capabilities to support fighter assets. Advanced location beneficial, but extensive management, organizational, and infrastructure changes and additions required for permanent operational F-22A beddown. Not a candidate for a new fighter squadron of F-22A operational aircraft at this time.
2. **Eielson AFB.** Not a current F-15 aircraft location. Extensive infrastructure construction would be required. Good airspace for training of F-16-type multiple mission aircraft or A-10 air-to-ground support aircraft. Weather conditions in the interior of Alaska could affect seasonal training. Not a candidate for beddown of F-22A operational aircraft at this time due to no F-15 mission and potential concentration of limited F-22A operational assets in extreme weather conditions.
3. **Elmendorf AFB.** Selected as the location for the second F-22A operational wing beddown. Base is retaining F-15 aircraft and adding F-22A aircraft. Extensive construction is involved with facilities to support the second F-22A operational wing. Not a candidate for an additional F-22A squadron at this time.
4. **Hickam AFB.** Existing portion of the base is dedicated to operational F-15 fighter mission, existing fighter management and communication. Lack of varied terrain under the airspace offset by benefits of integrating ANG personnel into the F-22A support and training programs. Existing ANG dedicated base area with facilities and infrastructure. Carried forward as a candidate for operational F-22A aircraft beddown at this time.

Hickam AFB meets the original selection criteria (Table 2.1-1), meets national needs for location, and has the current ability to accommodate operational F-22A aircraft. Hickam AFB is well positioned to support the missions of the F-22A because Hickam has air-superiority F-15 and ANG aircraft support capabilities. Hickam AFB command and control, other infrastructure and administrative capabilities, and training airspace are suited to the replacement of F-15 by F-22A operational aircraft.

2.1.3 Alternatives Carried Forward: Facility Locations on Hickam AFB

The beddown location described in Section 2.1.2 represents the Proposed Action configuration for replacing HIANG F-15 aircraft with F-22A aircraft. The renovation and construction within HIANG existing area on Hickam AFB is best able to meet the F-22A operational requirements without disrupting other operations at Hickam AFB.

Operational pilots must continually train to maintain skills essential for combat. Existing Hawaiian airspace would meet the training needs of F-22A pilots based at Hickam AFB.

2.1.4 Alternatives Considered But Not Carried Forward

All six bases originally evaluated for F-22A operational squadrons, Eglin AFB, Elmendorf AFB, Langley AFB, Mountain Home AFB, Nellis AFB, and Tyndall AFB, have been designated through BRAC or other Air Force planning to receive substantial additional Air Force assets in the immediate future. These six bases are not candidate locations for a new operational F-22A squadron at this time. Recent experience with the War on Terror, combined with long-range strategic goals, require the integration of operational F-22A aircraft into the ANG and the location of operational F-22A aircraft on the Pacific Rim.

The four Air Force bases on U.S. territory that have access to the Pacific Rim are Andersen AFB (Guam), Eielson AFB, Elmendorf AFB, and Hickam AFB. Andersen AFB does not have a fighter squadron, fighter command and control, or a fighter infrastructure and services primarily large transient aircraft. Eielson AFB, Alaska, has an F-16 fighter squadron, but does not have an operational F-15 air superiority squadron. Of the two bases with F-15 air superiority fighters, Elmendorf AFB, Alaska is already scheduled to receive two squadrons of F-22A aircraft. Hickam AFB is the only base that meets the original operational F-15 squadron siting criteria, provides rapid access to the Pacific Rim, and has the added benefit of integrating the most advanced Air Force weapon system into an ANG squadron. In addition, Hickam AFB is closer to the areas of conflict than Eielson or Elmendorf. Hickam is ideally situated in the Western Pacific to provide easy reach to key regional strategic locations.

Hickam AFB is carried forward as the proposed location for replacing the HIANG operational F-15 squadron with an F-22A operational squadron.

2.2 Elements Affecting Hickam AFB

The proposed beddown of a HIANG F-22A operational squadron to replace the current HIANG F-15 operational squadron could affect three aspects of the base:

1. The beddown and flight activity of a new aircraft with different performance characteristics from existing aircraft could affect the base and its environs. This section describes existing and proposed flight activities near the base.
2. The beddown would require the planning, design, renovation, and construction of facilities at Hickam AFB over a period of approximately 5 years.
3. The beddown would affect the responsibilities, but not the numbers, of base personnel.

2.2.1 Proposed Base Operations

F-22A aircraft would use the base runways and fly in the base environs similar to the comparably sized F-15 aircraft do today. This includes take-off and landings, training, and deployments. The HIANG is working with the Federal Aviation Administration (FAA) to modify the proposed F-22A approach pattern and reduce the potential for off-base noise complaints.

The HIANG 199 FS anticipates that the F-22A operational squadron would fly approximately 4,320 sorties per year. Depending upon the projected requirements and deployment patterns under the Aerospace Expeditionary Forces (AEF) program, the F-22A operational squadron would be expected to fly no less than 60 percent of these sorties from Hickam AFB in any given year.

The operational F-22A squadron proposed for Hickam AFB would be integrated into the Air Force's Expeditionary Air Force (EAF) Construct. The EAF Construct grew out of the need for the U.S. to deploy forces worldwide despite the reduction in U.S. overseas basing

> A sortie is the flight of a single aircraft from take-off to landing.

and personnel. Under the EAF, the Air Force has divided its forces into 10 AEFs and 2 Aerospace Expeditionary Wings to make worldwide deployments more predictable and manageable. An AEF is a "package" (group of different types of aircraft with a mixture of capabilities suited to the tasking) deployed to overseas locations for about 120 days. These AEFs consist of wings or squadrons from multiple U.S. bases that operate as a unit or are integrated with other forces overseas. Pre- and/or post-deployment training, at locations other than a "home" base, also occurs for about another 30 days out of the year. Squadrons or wings at the bases are rotated into the AEF program on a 20-month cycle. Hickam AFB's F-15 squadron is currently part of the AEF program.

On average, the HIANG F-22A squadron would be deployed for 150 days per AEF cycle (120 days AEF and 30 days pre- or post-AEF training). In addition, HIANG F-22As would participate in training exercises and operate out of another U.S. or overseas base for an average of one week per year, flying another 220 sorties at remote locations other than Hickam AFB. Some of the F-22A sorties while deployed would involve ordnance delivery training or missile firing at approved ranges such as the Nellis Range Complex in Nevada; Utah Test and Training Range; or Eglin AFB ranges, including over-water ranges in the Gulf of Mexico.


HIANG AIRCREWS FULFILL AFTER-DARK FLYING REQUIREMENTS WHENEVER POSSIBLE BY FLYING BEFORE ENVIRONMENTAL NIGHT, WHICH IS FROM 10:00 P.M. TO 7:00 A.M.

HIANG F-22As would fly the same percentage (30 percent) of sorties after dark (i.e., about one hour after sunset) as required for the F-15 under the Air Force's initiative to increase readiness. Fulfilling annual night flying requirements to the extent possible without flying after 10:00 p.m. or before 7:00 a.m. is designed to be consistent with the Hickam AFB noise abatement program.

F-15 aircraft use afterburner for take-off the majority of the time, depending upon factors such as temperature and humidity. Larger engines and improved aerodynamics on the F-22A would make it so that the F-22A would not use afterburners 95 percent of the time for take-off.

Hickam F-15s have a responsibility to perform air-to-air protection of the Hawaiian Islands. F-15 aircraft have an alert mission from Hickam AFB with air-to-air weapons. The F-22A based at Hickam AFB would be expected to fulfill the same mission with live air-to-air weapons.

2.2.2 Proposed HIANG Facilities

The F-22A is a new weapons system. As such, the F-22A requires additional or upgraded facilities to ensure the combat readiness and capability of the system. These renovated and new facilities would provide for and protect the F-22A characteristics noted in Section 1.1.2, including low observability, higher performance engines, advanced electronics, and maintenance procedures.


THE EXISTING HIANG F-15 SQUADRON IS PROPOSED TO BE REPLACED BY AN F-22A SQUADRON.

There are limited options for facility locations at Hickam AFB to accomplish the Proposed Action. The HIANG F-15 squadron is a tenant on Hickam AFB and occupies a 128 acre area on the south central portion of the base. Hickam AFB has as its primary role the requirement to support large transport and cargo aircraft. Ramp parking space and room for new facilities are limited. The replacement of one squadron of F-15 aircraft with one squadron of nearly the same length, width, and height of F-22A aircraft requires no additional ramp space. Figure 2.2-1 presents an overview of existing and proposed HIANG fighter specific infrastructure.

Table 2.2-1 summarizes the facility requirements for the HIANG fighter aircraft replacement. The proposed replacement of one HIANG F-15 squadron with one F-22A squadron would change the PAI from 15 to 18 fighter aircraft. This would result in an increase in the number of fighter training flights from Hickam AFB.

Table 2.2-2 presents the types and number of aircraft currently assigned and proposed for Hickam AFB. This table permits a comparison of current aircraft assignments and proposed HIANG F-22A assignments. The number of proposed F-22A sorties is described in Section 2.1.

Hickam AFB supports operations of F-15, C-17, KC-135R, other aircraft, and transient aircraft. In addition, as a joint use facility, Hickam AFB shares runways with a range of commercial carriers and other civil aviation. On an annual basis, Hickam AFB has supported the levels of aviation operations shown in Table 2.2-3.

Around an airfield, ***aircraft operations*** are categorized as takeoffs, landings, or closed patterns (which could include activities referred to as touch-and-go's or low approaches). Each takeoff or landing constitutes one operation.

Renovated and new facilities to support HIANG F-22A aircraft would be located in the south-central portion of the base. This development would occur in the Hickam AFB Comprehensive Plan area designated as HIANG tenant space (see Figure 2.2-1). The proposal includes approximately 20 renovation, construction, or infrastructure improvement projects proposed over the period from FY 2009 to FY 2013, with a total FY 2007 dollar estimated cost of $146.4 million. Construction in this location would consolidate all F-22A mission facilities in the area allocated to HIANG fighter activities. Table 2.2-4 gives the annual estimated expenditure for planning, renovation, and construction of facilities at Hickam AFB.

Most renovation and construction would occur in 2010. In total, the renovation, construction, and infrastructure improvements would affect about 15 acres of previously disturbed ground within the HIANG fighter area. Affected acres represent the area covered by the construction footprints of the proposed facilities plus the surrounding lands where construction-related clearing and grading would occur. Infrastructure upgrades, such as connecting new facilities to water and power systems, would also count in the affected area.

The proposed renovation and construction of facilities would occur in the existing HIANG support area.

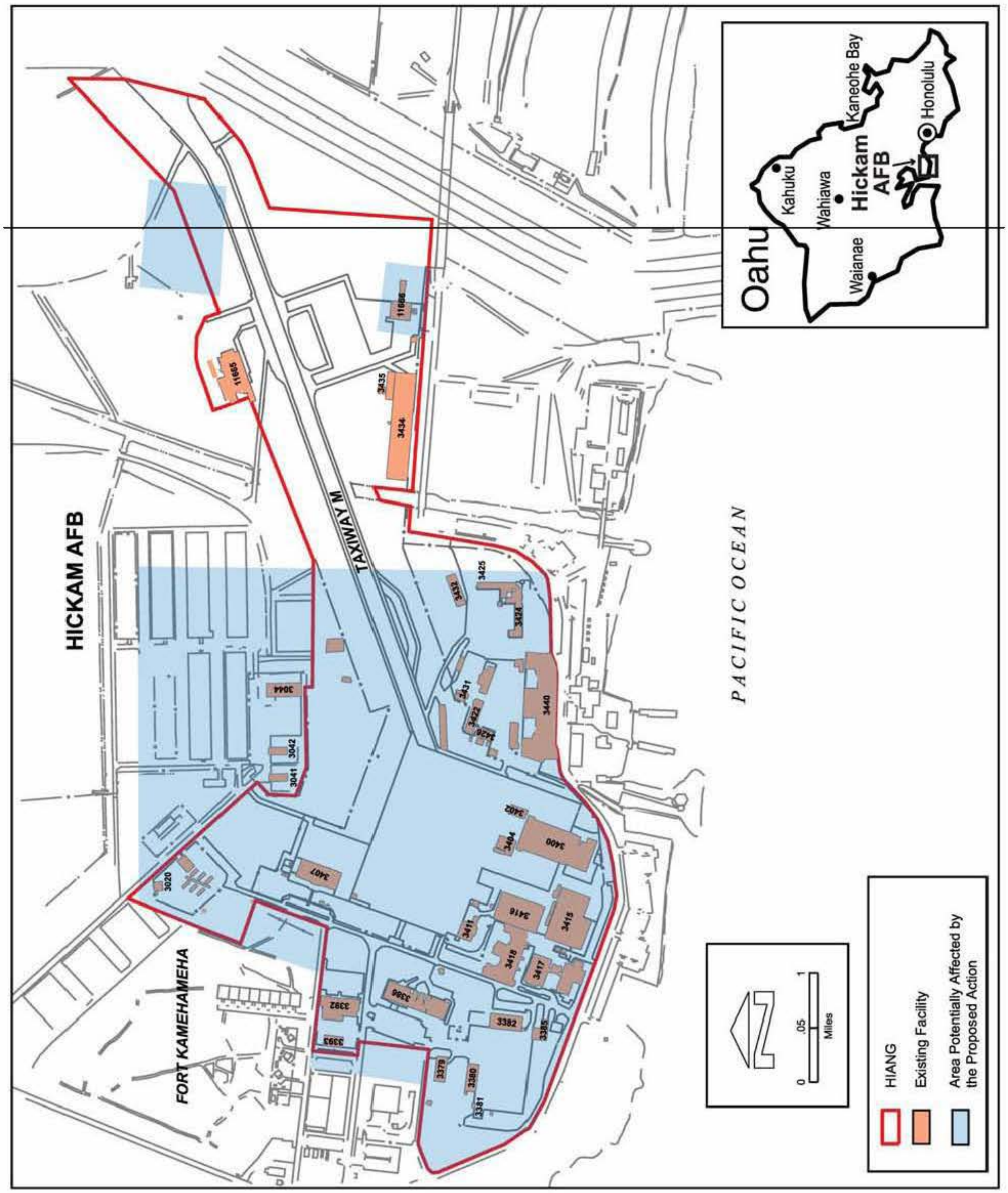


Figure 2.2-1. Area Potentially Affected by Fighter Specific Infrastructure Changes on Hickam AFB

Table 2.2-1. Proposed Facility Actions to Support F-22A Aircraft

Building Number	*Project Type*	*Projected FY*	*Proposed Action*
3020	Petrol Operations	2010	Alteration
3041	Munitions Storage Igloo	2010	Alteration
3042	Munitions Storage Igloo	2010	Alteration
3044	Munitions Maintenance Shop	2010	Alteration
3379	Warehouse Supply	2009	Demolition
3385	Communications Facility	2017	Demolition
3386	Weapons and Release Systems Shop	2010	Alteration
3400	Hangar and Squadron Operations	2010	Demolition
3402	Aircraft Maintenance Shop	2010	Demolition
3404	Squadron Operations	2010	Demolition
3407	Fuel Cell Corrosion Control	2012	Alteration
3415	Warehouse Supply	2009	Demolition
3416	Jet Engine Maintenance Shop	2010	Alteration
3422	Aircraft Maintenance Shop	2010	Demolition
3424	Aerospace Ground Equipment Maintenance Shop/Vehicle Maintenance Shop	2010	Alteration
3425	Battery Room	2010	Alteration
3426	Aircraft Maintenance Shop	2010	Demolition
3431	General Purpose Shop (Aircraft)	2010	Demolition
3434	Aircraft Maintenance Shop	2010	Demolition
3435	Aircraft Maintenance Shop	2010	Demolition
11666	Hush House	2010	Alteration
TBA	Low Observable/Composite Repair Facility	2010	Construction
TBA	Squadron Operations/Aircraft Maintenance Unit/6-Bay Hangar	2010	Construction
TBA	Fuel Tank Storage	2010	Construction
TBA	Field Training Detachment	2010	Construction
TBA	Weapons and Release Shop	2010	Construction
TBA	F-22A Simulator Facility	2011	Construction
TBA	Weapons Load Training Facility	2011	Construction

TBA = To Be Assigned

Table 2.2-2. Baseline and Proposed Aircraft (PAI) Assigned to Hickam AFB

Aircraft Type	Number Assigned	
	Baseline	*Proposed*
F-15	15	0
F-22A	0	18
C-17	8	8
C-20	1	1
C-37	2	2
C-40	1	1
KC-135R	8	8[1]

Note: 1. An additional 4 KC-135Rs are proposed as a separate action and discussed in Chapter 5.0.

Table 2.2-3. Hickam AFB/Honolulu Airfield Annual Operations

Fiscal Year	*Civil Aviation*	*Military Aviation*	*Total[1]*
2003	289,577	16,088	305,665
2004	303,174	17,101	320,275
2005	315,727	14,819	330,546

Note: 1. Annual operations include take-offs, landings, and closed patterns.

Table 2.2-4. HIANG Annual Facility Expenditure (in FY 2006 dollars)

FY	*Estimated Construction and O&M Costs (M)*
2008	15.3
2009	25.5
2010	75.2
2011	26.5
2012	3.9

On-base weapons safety quantity-distance (QD) for the F-22A will increase. The quantity-distance (QD) arc is calculated based on the spread of materials from an accidental explosion. The F-22A carries the same munitions internally as the F-15 does externally. An internal explosion is calculated to spread more materials, including parts of the aircraft, over a larger area. The F-22A QD arc (758 foot radius) is larger than the F-15 QD arc (400 foot radius). The 154 WG will submit a required updated Explosive Site Plan for Hickam in accordance with AFI 91-201. Chapter 4 of this updated plan will account for this QD increase and its relationship to surrounding work areas.

Construction of the Low Observable/Composite Repair Facility, the Squadron Operations, and the F-22A Simulator represent the most substantial new construction projects proposed at the HIANG complex. These projects account for 75 percent of the new construction. No new military construction projects are proposed for the F-22A beddown outside Hickam AFB.

Demolition Activities. Prior to renovation or demolition of a facility, HIANG would contract to have any asbestos-containing materials and lead-based paint removed and properly disposed of in accordance with federal and state regulations. Site preparation would include establishing a buffer zone around the involved facilities. The proposed demolition would include complete dismantling and removal of all facility structures, equipment and machinery, in accordance with applicable regulatory requirements to ensure proper handling and disposition of the waste. All utilities would be capped or disconnected. Materials from all facilities proposed for demolition would be recycled to the greatest extent practicable.

The demolition contractor would dispose of the remaining materials in an approved landfill in accordance with Hawaii and federal regulations and utilize an established haul route for equipment delivery and debris removal. Demolition would involve minimal ground disturbance and any areas that may be disturbed by demolition would be restored to prevent any long-term soil erosion. Frequent spraying of water on exposed soil during ground disturbance and demolition activities, proper soil stockpiling methods, and prompt replacement of ground cover or pavement are standard construction procedures that would be used to minimize the amount of dust generated during demolition.

Renovation and Construction Activities. Prior to renovation, construction, or demolition at any site, a construction laydown area and haul route would be established and coordinated with the Base Civil Engineering Squadron. Appropriate erosion and siltation controls would be implemented and maintained in effective operating condition prior to and throughout all construction and demolition activities.

With the start of building construction, each building site would be graded and sediment and erosion controls would be installed. These standard construction practices would include the installation of a silt fence, storm drain inlet protection, temporary sediment traps, and diversion dikes within project limits prior to commencement of any on-site work. All development activities would be performed in accordance with current security and force protection requirements.

Fugitive dust would be controlled by the use of standard construction practices. In all cases where construction disturbs the existing vegetation or other ground surface, the contractor would revegetate the area as approved by the base or restore the surface as directed by the base.

The HIANG will ensure that a proper Base Civil Engineer Work Clearance Request Form (Air Force Form 103) is processed and routed through Civil Engineering for each construction area in accordance with AFI 32-1007 (2006).

2.2.3 Proposed HIANG Personnel

The F-22A is a new weapons system with different maintenance requirements. Much of the on-site maintenance is accomplished by a parts removal and replacement as compared with on-site repair of parts. Fewer personnel, particularly for maintenance, would be needed for an F-22A squadron than for an F-15 squadron. The F-15 HIANG squadron is comprised of 270 full-time and an estimated 400 part-time positions for a total of 670 full- and part-time positions. To the extent possible, HIANG F-22A personnel positions would be drawn from the equivalent positions associated with existing manpower authorizations. The F-22A squadron has an estimated 460 full-time equivalent personnel requirement. An estimated 350 full-time (combined active duty and ANG) personnel would be associated with the F-22A at Hickam AFB. These full-time positions would be supported by an additional 250 to 350 part-time HIANG personnel. As such, total HIANG on-base personnel would not substantively change from the personnel numbers associated with the replaced F-15 squadron. The personnel affected could be given different personnel assignments and the hours of assignment could change with the proposed new system.

2.2.4 No Action Alternative at Hickam AFB

No Action for this EA means no beddown of an HIANG F-22A operational squadron at Hickam AFB at this time. Analysis of the No Action Alternative provides a benchmark and enables decision-makers to compare the magnitude of the environmental effects of the proposal. Section 1502.14(d) of NEPA requires an EA to analyze the No Action Alternative. In this case, one F-15 squadron is proposed to be replaced by one F-22A squadron. If No Action resulted in no F-22A aircraft being assigned to HIANG at Hickam AFB, there would be no F-22A-related facility renovation or construction.

For this EA, No Action is the baseline condition, which currently has one squadron of F-15 aircraft based at Hickam AFB. Taking no action could negatively affect the overall program for integrating the F-22A as part of the ANG inventory. This could delay the fielding of the F-22A for operations and deployment. Delaying action could also add cost to the overall program.

2.3 Elements Affecting Training Airspace

F-22As at Hickam AFB would conduct similar missions and training programs to those of the F-15s. The HIANG expects that the F-22A would use the training airspace associated with Hickam AFB in a manner similar to the F-15s currently based there. Incidental monthly check flights would be conducted at some runways other than Honolulu International Airport runways. Emergency alternate airfields will be the same ones currently used by the F-15 and will primarily depend on the location of the aircraft when the emergency occurs. These fields include Barking Sands, Lihue, Kalaeola, Kaneohe Marine Corps Base Hawaii, Hilo, and Kona.

All F-22A flight activities would take place in existing airspace; no airspace modifications are proposed for the F-22A at this time as part of this beddown proposal. The four types of Hawaiian military aircraft training airspace are presented in Figure 2.3-1. Offshore Warning Areas and associated Air Traffic Control Assigned Airspaces (ATCAAs) are used by Hickam AFB-based F-15 aircraft and are proposed for use by F-22A aircraft. HIANG F-22A training is not proposed for Military Operations Areas (MOAs), Military Training Routes (MTRs), or military training ground ranges on any Hawaiian island.

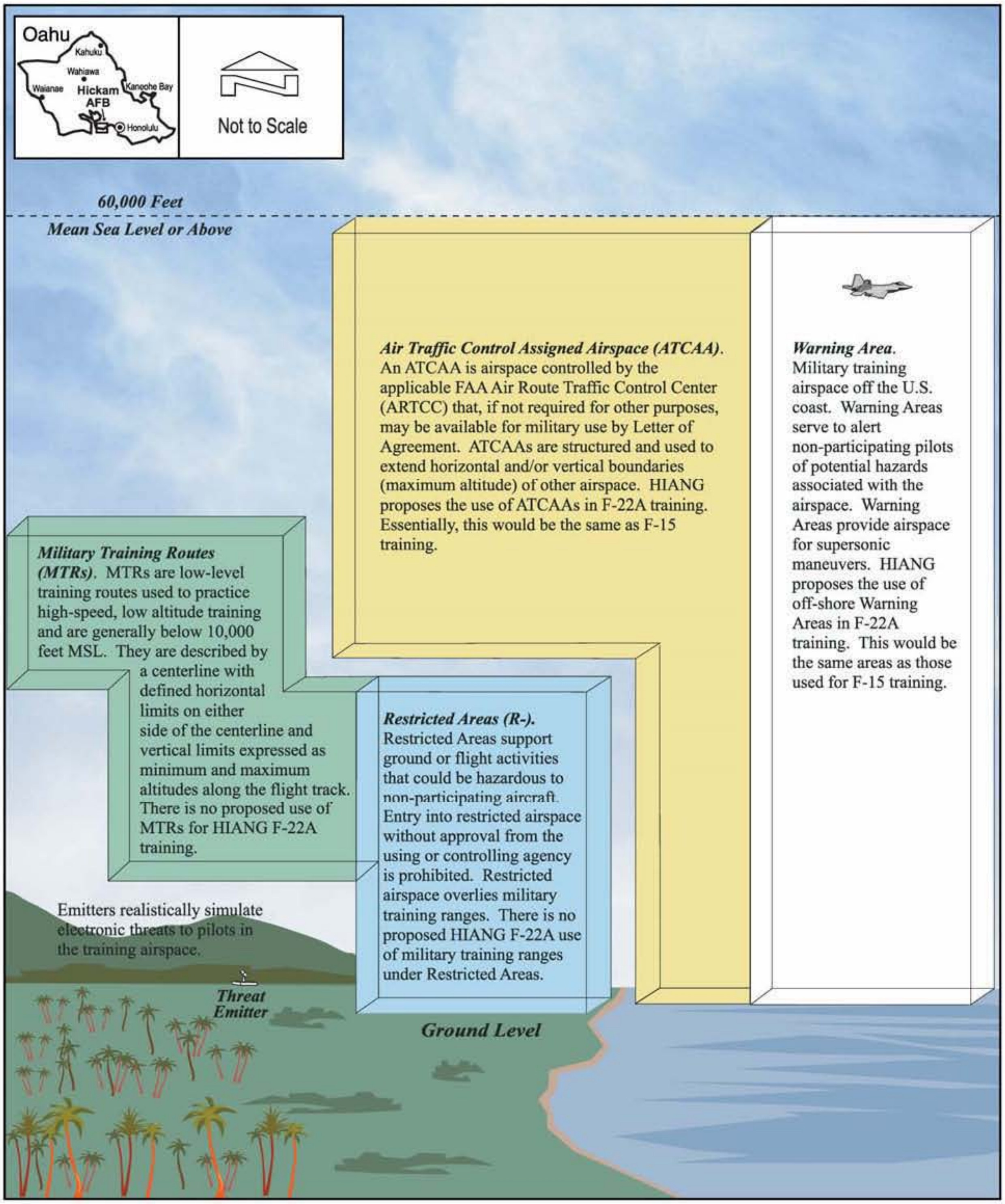


Figure 2.3-1. Types of Training Airspace, Hickam AFB, Hawaii

The F-22A has numerous mission requirements. Table 2.3-1 describes the projected F-22A air superiority missions and training similar to those performed by the F-15 aircraft currently assigned to the HIANG. The F-15 currently performs live-fire air-to-air training at ranges authorized for such training. This includes the capability to perform live air-to-air munitions training within airspace associated with the Pacific Missile Range. The F-22A would propose to use the same airspace for comparable air-to-air training with live munitions. F-22A training flights would closely match those performed by operational F-15 aircraft in terms of nature and duration. Training would occur in the existing offshore airspace with altitudes from surface to unlimited.

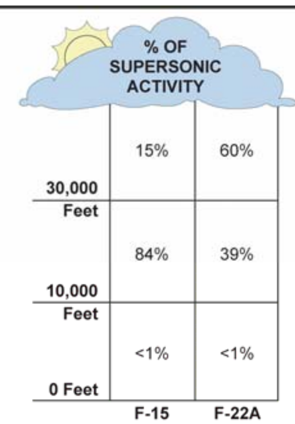
THE F-22A SPENDS MORE TIME TRAINING AT HIGHER ALTITUDES THAN THE F-15.

In addition to the air superiority mission, the F-22A has an air-to-ground mission. Table 2.3-2 presents simulated air-to-ground training activities projected for F-22A in the Warning Areas. The F-22A typically would fly unrefueled missions of approximately one and one-half to two-hours, including take-off, transit to and from the training airspace, training activities, and landing. Depending upon the distance and type of training activity, the F-22A could spend between 20 to 60 minutes in a training airspace. On occasion during an exercise, the F-22A may spend up to 90 minutes in one or a set of airspace units. On average, the F-22A would fly the same percentage of time after dark (30 percent) as does the F-15 currently using the airspace.

Although the F-22A could use the full, authorized capabilities of the training airspace from surface to above 60,000 feet MSL, the F-22A would rarely (5 percent or less) fly below 5,000 feet MSL. As noted in Table 2.3-3, the F-22A consistently flies from 10,000 feet to above 30,000 feet MSL.

The F-22A would employ supersonic flight to train with the full capabilities of the aircraft. All supersonic flight would occur at altitudes and within airspace already authorized for such activities. The F-22A would fly approximately 25 percent of the time at supersonic speed in comparison to the F-15, which commonly conducts supersonic flight for about 7.5 percent of the time. The F-22A would fly higher and at supersonic speeds more often than the F-15. The F-22A has greater performance capabilities and pilots must train to use those capabilities.

The F-22A has superior performance capabilities for several reasons. First, the F-22A can fly at supersonic speed without the use of afterburners (known as "supercruise"). This means that F-22A pilots can attain supersonic speeds in the course of normal maneuvering without lighting the afterburner, which also saves fuel. The F-22A's improved aerodynamics permit it to cut through the air easily and enables it to fly faster with less resistance. Finally, in terms of its mission, more frequent use of supersonic speeds provides an advantage when engaging enemy aircraft, surface-to-air missiles when accessing or leaving a battlespace, or when simulating air-to-ground attacks. Supersonic speed enables the F-22A to close on its target and employ its weapons more rapidly than an aircraft with less supersonic capability. After launching a missile, the F-22A can use its speed to evade adversary missiles and aircraft. More than 99 percent of supersonic flight would be conducted above 10,000 feet, with 60 percent occurring above 30,000 feet.



F-22A would conduct a higher percentage of their supersonic activity at higher altitudes than F-15 aircraft.

Table 2.3-1. Projected F-22A Training Activities Similar to F-15 Training

Activity	*Description*	*Time in Airspace*
Aircraft Handling Characteristics	Training for proficiency in use and exploitation of the aircraft's flight capabilities (consistent with operational and safety constraints) including, but not limited to high/maximum angle of attack maneuvering, energy management, minimum time turns, maximum/optimum acceleration and deceleration techniques, and confidence maneuvers.	0.5 to 1.0 hour
Basic Fighter Maneuvers	Training designed to apply aircraft (1 versus 1) handling skills to gain proficiency in recognizing and solving range, closure, aspect, angle, and turning room problems in relation to another aircraft to either attain a position from which weapons may be launched, or defeat weapons employed by an adversary.	0.5 to 1.0 hour
Air Combat Maneuvers	Training designed to achieve proficiency in formation (2 versus 1 or 2 versus 1+1) maneuvering and the coordinated application of Basic Fighter Maneuvers to achieve a simulated kill or effectively defend against one or more aircraft from a pre-planned starting position. Use of defensive countermeasures (chaff, flares). Air Combat Maneuvers may be accomplished from short-range to beyond visual range.	0.5 to 1.0 hour
Low-Altitude Training	Aircraft offensive and defensive operations at low altitude, G-force awareness at low altitude, aircraft handling, turns, tactical formations, navigation, threat awareness, defensive response, defensive countermeasures (chaff/flares) use, low-to-high and high-to-low altitude intercepts, missile defense, combat air patrol against low/medium altitude adversaries.	0.5 to 1.0 hour
Tactical Intercepts	Training (1 versus 1 up to 8 versus multiple adversaries) designed to achieve proficiency in formation tactics, radar employment, identification, weapons employment, defensive response, electronic countermeasures, and electronic counter countermeasures.	0.5 to 1.0 hour
Night Operations	Aircraft intercepts (1 versus 1 up to 8 versus multiple adversaries) flown between the hours of sunset and sunrise, including tactical intercepts, weapons employment, offensive and defensive maneuvering, chaff/flare, and electronic countermeasures.	0.75 to 1.5 hour
(Dissimilar) Air Combat Tactics	Multi-aircraft and multi-adversary (2 up to 8 versus multiple to larger force exercises) conducting offensive and defensive operations, combat air patrol, defense of airspace sector from composite force attack, intercept and simulate and destroy bomber aircraft, destroy/avoid adversary ground and air threats with simulated munitions and defensive countermeasures, strike-force rendezvous and protection.	0.5 to 1.0 hour

Table 2.3-2. Projected F-22A Simulated Air-to-Ground Training Activities

Activity	*Description*	*Time in Airspace*
Navigation and Basic Surface Attack	Navigation and air-to-ground simulated delivery of ordnance.	0.5 to 1.0 hour
Tactical Weapons Delivery	More challenging multiple attack headings and profiles. Supersonic speeds that can include target acquisition are added to the challenge.	0.5 to 1.0 hour
Surface Attack Tactics	Practiced up to supersonic speeds. Defensive countermeasures may be deployed. Precise timing during the ingress to the target is practiced, as is target acquisition. Training includes egress from the target area and reforming into a tactical formation.	0.5 to 1.0 hour
LRSOW Delivery	Precise timing for speed, altitude, and launch parameters is practiced at high altitudes without release up to and in excess of supersonic speeds. Remote training using LRSOW at authorized ranges outside Hawaii.	0.5 to 1.0 hour
Suppression of Enemy Air Defenses	Highly specialized mission requiring specific ordnance and avionics and can include supersonic speeds and defensive countermeasures. The objective of this mission is to simulate neutralizing or destroying surface anti-aircraft systems	0.5 to 1.0 hour
Large Force Exercises/Mission Employment	Multi-aircraft and multi-adversary composite strike force exercise (day or night), air refueling, strike-force rendezvous, conducting simulated air-to-ground strikes, strike force defense and escort, air intercepts, electronic countermeasures, electronic counter-counter measures, combat air patrol, defense against composite force, bomber intercepts, destroy/disrupt/avoid adversary fighters, defensive countermeasure (chaff/flare) use.	0.5 to 1.0 hour

Table 2.3-3. Projected Comparable F-15 and F-22A Altitude Use

Altitude (feet)	*Percent of Flight Hours: F-15*	*Percent of Flight Hours: F-22A*
>30,000[1]	8	30
10,000-30,000	67	60
5,000-10,000	14	5
2,000-5,000	8	3.75
1,000-2,000	2.75	1
500-1,000	0.25	0.25

Note: 1. Operations by F-22As would emphasize use of higher altitudes more often than F-15s.

Source: Personal communication, Marosko 2007

HIANG has a noise avoidance program that considers current meteorological conditions and the potential for sonic booms generated in Warning Areas reaching land. Normal training operations occur approximately 50 nautical miles (NM) from land. Under certain meteorological conditions, or if other conditions contributed to sonic booms affecting land, training flights are moved to airspace further off shore.

F-22A operational aircraft would fly training flights in one or more of the Warning Areas. Activities in the training airspace are termed *sortie-operations*. A *sortie-operation* is defined as the use of one airspace unit by one aircraft. Each time a single aircraft flies in a different Warning Area, one sortie-operation is counted for that unit. Thus, a single aircraft can generate several sortie-operations in the course of a mission.

The affected Warning Areas and associated ATCAAs are currently used by the F-15 for training. Figure 1.3-2 presents these offshore training areas that permit maneuvers from the surface to as high as the F-22A can fly.

2.3.1 F-22A Training Flights Within Hawaiian Airspace

The F-22A has the potential to use missiles or a gun in air-to-air engagements. Training for the use of these weapons is predominantly simulated. Simulating air-to-air attacks uses all the radar and targeting systems available on the F-22A. F-22A live-fire training would occur at ranges authorized for such activities. The Pacific Missile Range is one such range authorized for air-to-air training with live munitions. Offshore ATCAAs extend the Warning Areas and cumulatively account for an estimated 5 percent of F-15 training. The F-22A would train approximately the same proportion of time in ATCAAs. For the purpose of this analysis, all sortie operations are concentrated in Warning Areas to estimate a potentially high-end use.

The current annual sortie-operations in the Warning Areas proposed for training are presented in Table 2.3-4. The F-15s use the Northern Warning Areas for 75 percent of all their training sortie-operations and the F-22As are expected to do the same. Table 2.3-4 compares existing training of F-15 aircraft with the proposed training activity of Hickam AFB-based F-22A aircraft.

Table 2.3-4. Baseline F-15 and Projected F-22A Annual Sortie-Operations in Warning Areas

Warning Area	**Baseline** *F-15*	**Projected** *F-22A*
188	1,076	1,620
189	2,153	3,240
190	1,076	1,620
192	240	360
193	240	360
194	240	360

The F-22A has an air-to-ground mission. F-22A pilots are projected to spend 70 percent of their training in air-to-air missions and 30 percent of their training in air-to-ground missions. The existing offshore Warning Areas provide adequate airspace for all F-22A training activities presented in Tables 2.3-1 and 2.3-2. The F-22As use avionics to simulate ordnance delivery on a target. This type of training could be conducted in any of the airspace Warning Areas. The HIANG F-22A operational squadron air-to-ground training would represent an important part of the F-22A training program, although air dominance mission training would continue as the priority.

Air-to-ground training in Hawaiian airspace would simulate, where the F-22A would reach launch speed and open bomb bay doors, as pictured, but would not release any munitions.

In combat, air-to-ground weapons could be released by an F-22A at supersonic speeds at altitudes up to 50,000 feet MSL. Actual air-to-ground ordnance delivery training at approved delivery profiles would occur during the times when the HIANG F-22A squadron would be deployed to other locations during special training cycles. Locations where levels of munition training is authorized could include the Nellis Range Complex in Nevada, the Utah Test and Training Range, and the approved ranges associated with Eglin AFB, Florida. Separate environmental analysis has been prepared for these installations to include transient users. An estimated 80 to 90 annual missions (approximately 3 percent of total F-22A missions) would be flown by the F-22As at exercises and training away from Hickam AFB. A portion of these missions would involve ordnance delivery training. The negligible level of use of these remote ranges and the current level of use by others suggest that projected HIANG F-22A use does not warrant additional detailed environmental analysis for these ranges.

2.3.2 Defensive Countermeasures

Chaff and flares are the principal defensive countermeasures dispensed by military aircraft to avoid detection or attack by enemy air defense systems. The F-15s currently use chaff and flares during training. Although the F-22A's low observability features reduce its detectability, pilots must still train to employ defensive countermeasures. F-22As would use R-180A/AL chaff and MJU-10/B or equivalent flares in Warning Areas. Defensive chaff and flares are used to keep aircraft from being successfully targeted by weapons such as surface-to-air missiles, anti-aircraft artillery, or other aircraft. Appendix A describes the characteristics of chaff and Appendix B describes the characteristics of flares used in defensive training.

Effective use of chaff and flares in combat requires frequent training by HIANG aircrews to master the timing of deployment and the capabilities of the defensive countermeasure, and by ground crews to ensure safe and efficient handling of chaff and flares. Defensive countermeasures deployment in Hickam AFB authorized airspace is governed by a series of regulations based on safety, environmental considerations, and defensive countermeasures limitations. These regulations establish procedures governing the use of chaff and flares.

A bundle of chaff consists of approximately 0.5 to 5.6 million fibers, each thinner than a human hair, that are cut to reflect radar signals and, when dispensed from aircraft, form an electronic "cloud" that breaks the radar signal and temporarily hides the maneuvering aircraft from radar detection. The chaff fibers are dispersed and ten plastic or Mylar pieces fall to the surface with each F-22A deployed chaff bundle. Three plastic or felt pieces fall to the surface with each F-15 deployed chaff bundle.

Flares ejected from aircraft provide high-temperature heat sources that mislead heat-sensitive or heat-seeking targeting systems. The same types of flares are used for the F-15 and the F-22A. Flares burn for 3 to 4 seconds at a temperature in excess of 2,000 degrees Fahrenheit to simulate a jet exhaust. During the burn, a flare descends approximately 400 feet. The burning magnesium pellet is completely consumed and four or five plastic pieces and aluminum-coated Mylar wrapping material fall to the water.

The F-22A is undergoing weapons test and evaluation at the Nevada Test and Training Range. Chaff and flare details and the actual amounts of chaff and numbers of flares deployed during training will be developed as F-22A tactics are refined.

Table 2.3-5 presents the existing F-15 and estimated F-22A chaff use. There is an annual projected net decrease in chaff bundles of 2,318.

Table 2.3-5. Existing and Proposed Chaff Use (Annually in bundles of chaff)

Aircraft	*Existing*	*Proposed*	*Change*
F-15	12,768	0	-12,768
F-22A	0	10,450	+10,450
Total	12,768	10,450	-2,318

Source: Personal communication, Faurot 2006

Table 2.3-6 summarizes the existing F-15 and proposed F-22A flare use. The F-22A would release an estimated 784 fewer flares per year in the Warning Areas than the number of flares used by the departing F-15 aircraft. The number of flares used in each Warning Area would be proportional to the number of sortie-operations conducted by the F-22As. Based on the emphasis on flight at higher altitudes for the F-22A, over 90 percent of F-22A flare release would occur above 10,000 feet.

Table 2.3-6. Existing and Proposed Flare Use (Annually in number of flares)

Aircraft	*Existing*	*Proposed*	*Change*
F-15	6,384	0	-6,384
F-22A	0	5,600	+5,600
Total	6,384	5,600	-784

Source: Personal communication, Faurot 2006

2.3.3 No Action Alternative Within the Hawaiian Airspace

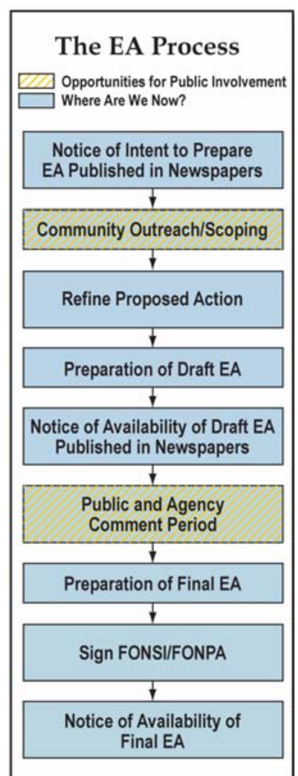
The No Action Alternative would not replace the HIANG F-15 squadron at Hickam AFB with an F-22A squadron at this time. Thirteenth Air Force mission requirements mean that No Action for the F-22A beddown could affect future mission capabilities. No Action for this EA is equivalent to baseline use of the base and airspace. Table 2.3-4, above, presents the airspace training associated with existing F-15 squadron. This airspace training would be expected to continue under No Action.

2.4 Environmental Impact Analysis Process

This EA for this F-22A operational squadron has been prepared in accordance with NEPA (42 USC 4321-4347), CEQ Regulations (40 CFR § 1500-1508), and 32 CFR Part 989, *et seq*., *Environmental Impact Analysis Process* (AFI 32-7061). NEPA is the basic national requirement for identifying environmental consequences of federal decisions. NEPA ensures that environmental information is available to the public, agencies, and the decision-maker before decisions are made and before actions are taken.

2.4.1 Environmental Assessment Process

The environmental analysis process, in compliance with NEPA guidance, includes public and agency review of information pertinent to the Proposed Action and No Action and provides a full and fair discussion of potential consequences to the natural and human environment. A community outreach/scoping meeting was conducted in Honolulu, Hawaii, on November 9, 2006 to involve the public and agencies, to identify possible consequences of an action, and to focus analysis on environmental resources potentially affected by the Proposed Action or the No Action Alternative. Interagency and Intergovernmental Coordination for Environmental Planning (IICEP) letters were sent on October 30, 2006 and responses received through November 2006. The Draft EA was made available on April 11 through May 14, 2007 for a public and agency review and comment period. A Notice of Availability was published in local newspapers and the document was available on the Hickam website, at local libraries, and distributed to a mailing list of interested parties.



2.4.2 EA Organization

A draft Finding of No Significant Impact (FONSI)/Finding of No Practicable Alternative (FONPA) is provided at the beginning of this EA. An Executive Summary follows the table of contents and summarizes the contents of this EA. The EA is organized into the following chapters and appendices. Chapter 1.0 describes the purpose and need of the proposal to replace HIANG F-15 aircraft with F-22A aircraft. A detailed description of the Proposed Action and the No Action Alternative is provided in Chapter 2.0. Chapter 2.0 provides a comparative summary of the effects of the Proposed Action and No Action Alternative with respect to the various environmental resources.

Chapter 3.0 describes the existing or baseline conditions at Hickam AFB and under the airspace. Chapter 4.0 describes the potential environmental consequences of the Proposed Action and the No Action Alternative. A full range of applicable environmental resources is presented for both the base and airspace. Chapter 5.0 presents a cumulative analysis, considers the relationship between short-term uses and long-term productivity identified for the resources affected, and summarizes the irreversible and irretrievable commitment of resources if the Proposed Action were implemented. Chapter 6.0 contains references cited in the EA and lists the individuals and organizations contacted during the preparation of the EA. A list of the document preparers is included in Chapter 7.0.

In addition to the main text, the following appendices are included in this document: Appendix A, Characteristics of Chaff; Appendix B, Characteristics and Analysis of Flares; Appendix C, Agency Coordination; Appendix D, Airspace Management; Appendix E, Aircraft Noise Analysis; Appendix F, Aircraft Operations Emissions Data.

2.4.3 Scope of Resource Analysis

The Proposed Action has the potential to affect certain environmental resources. These potentially affected resources have been identified through public scoping meetings, communications with state and federal agencies, and review of past environmental documentation. Specific environmental resources with the potential for environmental consequences include airspace management and air traffic control (including airport traffic), noise, safety, air quality, physical resources, biological resources, cultural resources, land use (including recreation and transportation), socioeconomics, and environmental justice.

2.4.4 Public and Agency Input

The Air Force and HIANG initiated early public and agency involvement in the environmental analysis of the proposed replacement of HIANG F-15 aircraft with F-22A aircraft. The Air Force published newspaper advertisements and distributed IICEP letters. These announcements solicited public and agency input on the proposal and invited the public and agencies to attend a scoping meeting in Honolulu on November 9, 2006. Table 2.4-1 presents details on the community outreach events.

Table 2.4-1. Community Outreach Scoping Meeting

Publication & Date	*Meeting Date*	*Meeting Location*
November 1, 2006	November 9, 2006 7:00 p.m. to 9:00 p.m.	Radford High School Cafeteria 4361 Salt Lake Blvd. Honolulu, Hawaii
Star Bulletin *Mid-Week* *Honolulu Advertiser*		
November 3, 2006		
The Kukini (Hickam AFB) *Army Weekly* *Navy News*		

Table 2.4-2 presents issues and questions identified by the public and government entities during scoping for this EA. Table 2.4-3 summarizes public and agency comments received during the 34-day public and agency comment period. The table provides a summary of the comment and directs the reader to the EA section number where the response may be found.

2.5 Regulatory Compliance

This EA has been prepared to satisfy the requirements of NEPA (Public Law [P.L.] 91-190, 42 USC 4321 *et seq.*) as amended in 1975 by P.L. 94-52 and P.L. 94-83. The intent of NEPA is to protect, restore, and enhance the environment through well-informed federal decisions. In addition, this document was prepared in accordance with Section 102 (2) of NEPA, regulations established by the CEQ (40 CFR 1500-1508), and AFI 32-7061 (i.e., 32 CFR Part 989).

Certain areas of federal legislation, such as the Endangered Species Act (ESA) and National Historic Preservation Act (NHPA), have been given special consideration in this EA. Implementation of the proposed HIANG replacement of F-15 by F-22A aircraft would require various federal and state reviews and permits.

Implementation of the Proposed Action would involve coordination with several organizations and agencies. Compliance with the ESA requires communication with the U.S. Fish and Wildlife Service (USFWS) in cases where a federal action could affect listed threatened or endangered species, species proposed for listing, or candidates for listing. The primary focus of this consultation is to request a determination of whether any of these species occur in the proposal area. If any of these species is present, a determination is made of any potential adverse effects on the species. Should no species protected by the ESA be affected by the Proposed Action, no additional action is required. Letters were sent to the appropriate USFWS and National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) offices as well as state agencies, informing them of the proposal and requesting data regarding applicable protected species. Appendix C includes copies of relevant coordination letters sent by the Air Force and notes members of the public and agencies who commented on the Draft EA. Those comments and the responses are summarized in Table 2.4-3.

The preservation of Native Hawaiian resources is coordinated by the State Historic Preservation Office (SHPO), as mandated by the NHPA and its implementing regulations. Letters were sent to potentially affected organizations informing them of the proposal (Appendix C). Further communication is included as part of this EA review process.

Hickam AFB is in attainment for all criteria pollutants and therefore an Air Conformity Review under the Clean Air Act (CAA) Amendments is not required. Emissions for air pollutants are below the *de minimis* threshold. The HIANG and Hickam AFB will work with the State of Hawaii Department of Health to prepare a permit to construct and operate new stationary sources.

Facility operations associated with the Proposed Action would be included under an amended version of the Hickam AFB 15 AW NPDES General Permit for stormwater associated with industrial activities. Additionally, adherence to the requirements of the NPDES construction permits as well as those in the Hickam AFB Stormwater Pollution Control Plan (SWPCP) would include implementation of best management practices (BMPs) to minimize the potential disturbance. The HIANG, in coordination with the Hawaii Coastal Zone Management Program Office of Planning, will execute a consistency determination process to ensure Coastal Zone Management concurrence.

Table 2.4-2. Summary of Public Comments and Notes from Scoping/Community Outreach

Commentor	*Question/Comment*	*Draft EA Section*
Scoping Comment Letter		
Office of Environmental Quality Control	How many F-22As will be stationed at Hickam?	2.0
	How often will they fly?	2.2.1
	How will their training affect Honolulu International Airport with their increasing flights in and out of Honolulu?	2.2.1, 3.1.2, 4.1.1
State of Hawaii Department of Health	The U.S. Army Corps of Engineers (USACE) should be contacted for this project.	Appendix C
	An application for a National Pollutant Discharge Elimination System (NPDES) should be submitted at least 180 days before the commencement of the respective activities.	2.5, 4.5.1
	A Notice of Intent to be covered by a NPDES general permit is to be submitted at least 30 days before the commencement of the respective activity.	2.5, 4.5.1
	The applicant for a NPDES permit is required to either submit a copy of the new Notice of Intent or NPDES permit application to the State Department of Land and Natural Resources, State Historic Preservation Division (SHPD), or demonstrate to the satisfaction of the Department of Health that the project, activity, or site covered by the Notice of Intent or application has been or is being reviewed by SHPD.	2.5, 4.5.1
State of Hawaii Office of Hawaiian Affairs	Will there be ground disturbance and how much?	2.2.2
	The Air Force must contact applicable agencies and cease work should iwi kūpuna or Native Hawaiian cultural or traditional deposits be found.	3.7, 4.7
Scoping Comments Received During Meeting		
Individuals from the Honolulu International Airport, USACE, and Federal Aviation Administration (FAA)	What will be the increase in noise?	4.2
	Where will noise mostly be noticed?	4.2
	What will be the noise contours?	4.2
	FAA will probably receive more noise complaints; what can the HIANG do to help them answer complaints?	2.2.1, 4.2
	If the FAA keeps the same take-off and/or landing patterns, what will be the noise distribution?	4.2
	Will the F-22A require different take-off and/or landing patterns?	4.1.1
	Where will the air-to-air and air-to ground training occur?	Figure 1.3-2, 3.1.3.1
	Will there be training in HI over land airspace?	3.1.3
	Will munitions be released during training?	1.4.2, 4.3.1
	Will the HIANG train with the Army?	4.1.1
	How does the HIANG treat and identify alternatives?	2.1
	What buildings will be changed?	2.2.2
	What new buildings will be constructed?	2.2.2, 4.8
	How will contracting for the construction be done?	4.9.1.1
	Will there be construction on parts of the base other than the HIANG area?	2.2.2, 4.8

Table 2.4-3. Draft EA Public and Agency Comments (Page 1 of 8)

Resource	*Commentor*	*Summarized Comment*	*EA Section and Response to Comment*
Purpose and Need	State of Hawaii, Department of Transportation	The commentor noted the discussion of the Honolulu International Airport runway system on page 1-6 is incorrect. There are four runways at Honolulu International Airport of lengths of 12,300 feet (8L-26R), 12,000 feet (8R-26L), 9,000 feet (4R-22L) and 6,700 feet (4L-22R). There are barrier arresting systems on Runways 8L, 4R, and 8R. There should be discussion on whether the arresting barriers will be used with the F-22A.	***EA Text Change:*** Page 1-6, Section 1.3, Replaced second to last sentence in first paragraph on page. There are four runways at Honolulu International Airport of lengths of 12,300 feet (8L-26R), 12,000 feet (8R-26L, 9,000 feet (4R-22L) and, 6,700 feet (4L-22R). Runways 8L, 4R, and 8R have barrier arresting systems. The F-22A would not be expected to use the arresting barriers any differently than they are currently used for the F-15.
DOPAA	State of Hawaii, Office of Hawaiian Affairs	The commentor noted the Draft EA discusses four locations that were considered for the beddown of this F-22A squadron. While Hickam AFB was selected because it met all of the selection criteria, it is unclear whether the other three locations considered also meet all of the selection criteria.	***Refer to Section*** 2.1.2. This section includes the summary review of the screening results. Hickam AFB was the only base that met all the screening criteria at this time. Andersen AFB and Eielson AFB are not current F-15 locations and extensive infrastructure would be required. Elmendorf was selected for the second operational F-22A wing beddown.
Airspace Management	U.S. Department of Transportation (DOT), FAA	The commentor stated that the HIANG has worked with the FAA to coordinate a proposed F-22A approach pattern to reduce the potential for noise consequences, but these were informal discussions and did not constitute formal coordination.	***Response:*** The HIANG considers all coordination with the FAA extremely important to developing the proposed action and alternatives in the environmental impact analysis process. HIANG personnel participated in discussions and meetings with the FAA during the preparation of the DOPAA and Draft EA related to modifying current F-15 approach procedures for F-22A operations and understand these interactions consisted of informal coordination. The intent of the discussions were to investigate the feasibility of adjusting current F-15 operational procedures to mitigate some of the potential noise impacts the F-22A aircraft would have on the communities surrounding the airport environment.
Airspace Management	DOT, FAA	Clarification was provided that Air Traffic Control is provided by Honolulu Control Facility (HCF), not Honolulu Center En Route Radar Approach (CERAP) and that Honolulu Air Route Traffic Control Center (ARTCC) has been replaced with HCF Approach.	***EA Text Change:*** Page 3-2, Section 3.1.2, Replaced Honolulu CERAP with Honolulu HCF and Honolulu ARTCC with HCF Approach.
Noise	DOT, FAA	The commentor observed that during times of increased traffic volume and Instrument Flight Rule weather, pilots of the F-22A may expect to be sequenced with all other aircraft on a first-come first-served basis. The HIANG should assess the likelihood of an F-22A straight-in final approach.	***Response:*** Noise modeling used for the report did include a representative percentage of sorties that would terminate with a straight-in approach versus a normal tactical arrival. These percentages were based on currently assigned F-15 operations where it was estimated that 15 percent of the landings to Runway 8L would be by straight-in final approach.

Table 2.4-3. Draft EA Public and Agency Comments (Page 2 of 8)

Resource	*Commentor*	*Summarized Comment*	*EA Section and Response to Comment*
Noise	DOT, FAA Lundberg	Table 3.2-1 lists the take-off/departure Maximum Sound Level (L_{max}) values for the F-22A using military power. The commentors believed it unreasonable to expect the HIANG to restrict all take-off profiles, including actual scrambles and exercises, to military power only.	***Response:*** There are many "metrics" or standard of measurements that can be used for noise analysis. For the purpose of this study, Military Power take-offs were used to compare the F-15 versus F-22A operations because that is the predominant power setting the F-22A will use for take-off. ***See Section*** 2.2.1, "The F-22A would not use afterburners 95 percent of the time for tak-off." This is an overall mission number. The data presented should not be interpreted that during each day 5 percent of the take-offs would use afterburner. As described in Section 3.2.1, Table 3.2.1, Note 2 which states "For Takepoff, F-22A uses Military Power (Most Common Departure)." Noise modeling included an average of 5 percent take-off with afterburners. Power settings used or noise modeling for take-off are a function of many variables such as meteorological conditions, weight of the aircraft, and available runway length. For noise modeling, activities during the course of a year are considered, and then normalized into a composite "average" day.
Noise	DOT, FAA	The commentor noted the HIANG should list the L_{max} values for afterburner take-offs in lieu of military power in the EA.	***Response:*** While it is very likely that HIANG f-22A will utilize afterburner take-offs for actual scrambles and exercises, these would be the exception rather than the rule and are projected to be included in the approximately 5 percent of the total number of take-offs with afterburners on an annual basis. This 5 percent of take-offs with afterburner was included in the noise modeling.
Noise	DOT, FAA	The Sound Exposure Levels (SEL) in Table 3.2-2 indicate that the F-22A, at higher altitudes, produces more noise than the F-15. The commentor questioned whether the departure will take the F-22A over Central Oahu, and, if so, would an expanded noise footprint north of Honolulu International Airport occur.	***Response:*** The noise footprint depicted north of the Honolulu International Airport accurately reflects the increased performance capability of the F-22A versus the F-15. Due to its greater thrust to weight ratio, the F-22A will level off at 16,000 feet over Central Oahu. The F-22A will be quieter than an F-15 that is typically only climbing through 10,000 feet.
Noise	DOT, FAA	A commentor suggested that the HIANG should develop a northbound departure procedure to keep the F-22A aircraft over the ocean, avoiding flight over the island of Oahu and densely populated areas.	***Response:*** Many different factors are considered when developing procedures to get an aircraft to and from its training airspace. One factor is fuel economy, especially with fighter aircraft that carry a limited amount of fuel. As an embedded member of our island community, the HIANG will do its part to investigate ways to minimize F-22A operational impacts to surrounding areas. Preliminary discussions with the FAA inquired into the possibility of increasing the departure altitude on the MELLO FOUR to account for the increased performance of the F-22A thereby further reducing the potential noise to communities in Central Oahu.

Table 2.4-3. Draft EA Public and Agency Comments (Page 3 of 8)

Resource	*Commentor*	*Summarized Comment*	*EA Section and Response to Comment*
Noise	Ebisu	The commentor expressed concern that the EA has no significant noise impacts over the Ewa area as a result of the F-22A noise contributions. Table 3.2-2 indicates that the F-22A is approximately 19.6 decibels (dB) (SEL) noisier than the F-15 it replaces when landing over Ewa. This increase in SEL per F-22A flyby event is equivalent to a cumulative increase in F-15 noise events by a factor of 90.3. In other words, replacing the F-15 with the F-22A would have the same effect on the cumulative noise contours over Ewa as would multiplying the number of F-15 landing events by a factor of 90.3. The commentor did not understand how the EA's noise contour results over Ewa did not change significantly with the replacement of the F-15 with the F-22A. The commentor did two noise model runs over Ewa for the Year 2010, and the western tip of the 65 Day-Night Average Sound Level (L_{dn}) contour increased from 8,000 feet west of Honolulu International Airport Runway 08L with the F-15 to 54,000 feet west of Honolulu International Airport Runway 08L with the F-22A. The commentor believes there would be a significant increase in noise impacted Ewa lands associated with the F-22A's 19.6 dB higher noise level.	***Response:*** The F-22A is approximately 90.3 (calculated at 93.3) times as loud as the F-15 at 2,000 feet altitude. HIANG is coordinating with the FAA to incorporate noise-reducing approach patterns for approximately 85 percent of the F-22A approaches. The differences in aircraft noise as well as differences in the approach pattern are taken into consideration in the noise model calculations which produced the noise contours in the EA. The raising of the approach altitudes during the time the F-22A is traversing the peninsula changes the noise exposure. At 3,000 feet, the F-22A's SEL is 98.8 A-weighted decibels (dBA) versus 103.1 dBA at 2,000 feet. When compared to the F-15 at 2,000 feet, the differential is 154 dBA, or a factor of approximately 34.7 times as great. In addition, the revised flight profiles developed for the F-22A somewhat reduce direct flight over Ewa. These changes in arrival procedures reduce both the incidence of exposure, and the level of exposure. This was incorporated into the noise modeling presented in the EA. ***See Section*** 4.2 and specifically Tables 4.2-2, 4.2-4, and Figure 4.2-2, which depict noise information to representative locations on the Ewa Peninsula.
Noise	Ebisu Lundberg	The commentors questioned that the F-22A's noise contribution to the total aircraft noise levels will be insignificant due to the large number of commercial aircraft in the mix. One commentor believes that the F-22A is the dominant aircraft noise source when modeling the conditions in 2010, since the commercial aircraft are so much quieter than the F-22A.	***EA Text Change:*** Page 4-4, Section 4.2-1, Table 4.2-2. Inserted the following after "Points of Interest in relation to the proposed noise contours are depicted on Figure 4.2-2." Table 4.2-2 compares the contributions of civil, other based military, and transient military operations with F-15 and F-22A operations impacting specific points on the Ewa Peninsula. The modeled noise contours reflect the HIANG proposed adjustments to approach patterns to apply noise avoidance approach procedures to approximately 85 percent of the F-22A arrivals. These data demonstrate that the noise is dominated by flight operations other than either the F-15 or the F-22A aircraft.

Table 2.4-3. Draft EA Public and Agency Comments (Page 4 of 8)

Resource	*Commentor*	*Summarized Comment*	*EA Section and Response to Comment*
Noise	DOT, FAA Ebisu	Commentors noted that Paragraph 4.2.1 is incorrect for the F-22A and pertains to the F-15. Commentors believed that property owners and other stakeholders on the Ewa side of the airport would need noise mitigation measures if the F-22A is as noisy on landing as indicated in the EA. The commentor did not see noise mitigation measures identified in the EA.	***Response:*** Noise reduction changes in approach patterns are included in the Proposed Action. ***EA Text Change:*** Page 4-7, Section 4.2.1, Replaced last paragraph with: Under the Proposed Action, the FAA and HIANG continue to work together to meet the needs of both agencies and identify workable solutions for the F-22A as they have done with the F-15. While F-22A specific procedures have yet to be developed, there are currently approved F-15 practices that minimize noise impacts on surrounding communities and the HIANG will work with the FAA to leverage that experience when developing F-22A procedures. Examples of HIANG and FAA coordination include the FAA-approved HIANG procedure that brings all fighter aircraft into Runway 4R for night operations and current FAA procedures which outline using Runway 4R in lieu of channel approaches to Runway 8L for commercial aircraft to reduce potential noise impacts to surrounding communities.
Noise	State of Hawaii, Department of Transportation	The commentor agreed that the cumulative noise contours will not change significantly especially if a circling approach becomes usual practice. The F-22A is rated at 111.3 dBA on landing compared to 88.5 for the F-15, but afterburners are not needed for take-off. There should be some discussion of the Noise Compatibility Program of Honolulu International Airport and the selective use of runways from 1900 to 0700 to minimize noise both in Ewa and Honolulu.	***Response:*** The HIANG is committed to continue to work within the Honolulu International Airport Noise Compatibility Program. The HIANG is also committed to use the circling approach procedures to the extent permitted by FAA. ***As explained in the EA*** Page 3-9, Section 3.2.2, this approach, combined with altitude adjustments, results in no or little cumulative noise contours.
Noise	Lundberg	The commentor observed that the Noise Abatement Departure and Landing Procedures are not shown in the EA nor is any altitude information given. The commentor requested information on the planned approach be included in the EA. Also, text should read *planned* noise abatement approach developed with FAA. It seems that the string-in approach is normal.	***Response:*** The flight tracks and flight profiles developed for the noise assessment in the document reflect aircraft flight parameters, operational considerations, location and anticipated use of training airspace, and improved air traffic control. While some noise reduction in specific geographic areas results from the incorporation of these considerations, they have not been formalized as "Noise Abatement Departure and Landing Procedures."
Noise	Lundberg	The commentor expressed concern that dispersion in flight operations could create changes in noise exposure contours. The commentor offered a series of other noise modeling techniques and theories.	***As described in the Draft EA*** Section 3.2, 4.2, and Appendix E, all modeling was accomplished using the Air Force's approved NOISEMAP model. The data contained in the model, and the calculation algorithms are accepted throughout the acoustic community. The operational dispersion for Honolulu International Airport/Hickam AFB is determined by FAA. The existing conditions, including the dominant commercial operations and F-15 fighter operations, are used to model noise exposure contours.

Table 2.4-3. Draft EA Public and Agency Comments (Page 5 of 8)

Resource	*Commentor*	*Summarized Comment*	*EA Section and Response to Comment*
Noise	Lundberg	The commentor requested adequate details of Air Force civil service and contractors affected by high noise exposures since the Occupational Health and Safety Administration (OSHA) 8-hour limits on noise exposure are 85 dB. With aircraft operations primarily during the working day; projected 75 to 80 dB L_{dn} is likely to exceed that limit, since the OSHA time-averaging period is much shorter.	***Response:*** The greatest noise exposure exists in the on-base area closest to the aircraft. Access to this area is controlled. where on-base human health or safety issues are of concern, bioenvironmental engineers designate areas as "High Noise Hazard" areas, and ensure that hearing protective devices are used in the area.
Noise	Lundberg	The commentor asked whether the F-22A would use 70 percent engine temperature ration on take-off or is this a cruise or approach power setting.	***Refer to*** Appendix E, Table 1 (page E-4), Footnote 1, explains that the settings are representative L_{max} for level flight, steady high-speed conditions. Data in Appendix E, Table 1 are comparative and are not addressing take-off noise.
Noise	National Oceanic and Atmospheric Administration National Marine Fisheries Service	Would sonic booms and associated impulsive noise be below the level of acoustic harassment for species protected by the Marine Mammal Protection Act? After review of the document, including appendices, the commentor notes, "it seems that [acoustic harassment] will not be a problem."	***As described in Appendix E*** no impact to marine species is expected. Appendix E describes sonic boom noise transmission between air and water and considers noise effects on marine mammal receptors. The analysis concludes that training would not result in acoustic harassment. Any subsequent environmental information on new aircraft missions or changes in sonic boom modeling results would be provided to appropriate resource management agencies for review.
Safety	State of Hawaii, Department of Transportation	The commentor recommended there be some discussion of the minimum length of runway required for an emergency landing by the F-22A. Honolulu International Airport has a reliever airport at Kalaeloa Airport with runway lengths of 8,000 feet, 6,000 feet, and 4,500 feet. Kahului Airport has runway lengths of 7,000 feet and 5,000 feet; Hilo has 9,800 feet and 5,600 feet; Kona has 11,000 feet; Lihue has 6,500 feet twice; and Kaneohe Marine Corps Air Station has 7,767 feet. Which of these runways might be chosen if an emergency landing was necessary?	***EA Text Change:*** Section 2.3. Incidental monthly check flights would be conducted at some runways other than Honolulu International Airport runways. Emergency alternate airfields will be the same ones currently used by the F-15 and will primarily depend on the location of the aircraft when the emergency occurs. These fields include Barking Sands, Lihue, Kalaeola, Kaneohe Marine Corps Base Hawaii, Hilo, and Kona.

Table 2.4-3. Draft EA Public and Agency Comments (Page 6 of 8)

Resource	*Commentor*	*Summarized Comment*	*EA Section and Response to Comment*
Natural Resources - Physical	State of Hawaii, Department of Health Department of the Army, U.S. Army Engineer District, Honolulu	The commentor noted the USACE needed more information to issue a definite determination on the proposed construction and renovation activities related to the Proposed Action. The commentor also observed that any project and its potential impacts to State waters must meet criteria outlined in Hawaii Administrative Regulation Sections 11-54-1.1, 11-54-3, and 11-54-4 through 11-54-8. The HIANG is required to obtain an NPDES permit for discharges of wastewater, including storm water runoff, into State surface waters (Hawaii Administrative Regulation, Chapter 11-55). For additional information on NPDES: http://www.hawaii.gov/health/environmental/water/cleanwater/forms/indiv-index.html. For additional information on Notice of Intent: http://www.hawaii.gov/health/environmental/water/cleanwater/forms/genl-index.html.	***Response:*** Compliance with the Hawaii Administrative Regulation Water Quality Standards applies to all activities on base. No F-22A related construction or renovation activities involve dredging or filling. ***See Section*** 3.5.2.2 Other Clean Water Act requirements of NPDES permitting for construction related storm water runoff, dewatering effluent, and hydro testing water do apply and are discussed in more detail in the base's Stormwater Pollution Control Plan (SWPCP). ***EA Text Change:*** Page 3-22, Section 3.5.2.2. Inserted as first paragraph: Section 404 of the Clean Water Act established a program to regulate the discharge of dredged or fill material into waters of the United States. The Rivers and Harbors Act of 1899 defined navigable waters of the United States as "those waters that are subject to the ebb and flow of the tides and/or are presently used, or have been used in the past, or may be susceptible to use to transport interstate or foreign commerce." This includes Hickam Harbor and the canals on base.
Natural Resources – Physical	Lundberg	The commentor noted that the EA asserts (Section 4.5.1, page 4-14) that the F-22A was the first to use a programmatic Environment, Safety, and Occupational Health Evaluation process, but noted that no high-performance aircraft engine development program to date has given programmatic consideration to noise as a factor.	***Response:*** Noise levels associated with operation of the F-22A engines have been well documented under controlled conditions at instrumented locations. Noise-related human health and safety issues have been addressed, and protective measures have been implemented where applicable. However, this does not mean that other benefits, such as reductions in hazardous materials and risks to other physical resources do not accrue as a result of incorporating the Programmatic Environment, Safety, and Occupational health Evaluation process.
Cultural Resources	State of Hawaii, Department of Transportation	The commentor suggested that some of the historical/cultural information regarding the Honolulu International Airport and Hickam AFB may have been inaccurate. The commentor provided additional detail on aviation history at Honolulu International Airport. Excellent references on aviation history in Hawaii are: Above the Pacific, Horvat, Aero Books, 1966 and Honolulu International Aiprot-The First 80 Years, HDOT, 2007.	***Response:*** The 1934 date for the construction of the Hickam Army Aerodrome was obtained from the Hickam AFB Cultural Resources Management Plan. ***EA Text Change:*** The additional detailed information regarding the aviation history of the Hickam AFB/Honolulu Airport has been edited into Section 3.7, Page 3-37, paragraph 4 has been revised. Sentence 1 "1916" replaced with "1913," the phrase "World War I was underway in Europe" has been replaced with "A Signal Corps Aviation Station was assigned to Fort Kamehameha." Sentence two, beginning with "The first of several key airbases…" has been revised with the insertion of "while World War I was underway in Europe" after the phrase "of Pearl Harbor on Oahu."

Table 2.4-3. Draft EA Public and Agency Comments

Resource	*Commentor*	*Summarized Comment*	*EA Section and Response to Comment*
Cultural Resources	Department of the Army, U.S. Army Engineer District, Honolulu	The commentor noted that some portions of the area of potential effect (APE), as depicted in Figure ES-2, may require archaeological monitoring, based on the results of previous work in the area. We suggest you work with the cultural resources specialists based at Hickam AFB to include this information in the Draft EA.	***Response:*** The cultural resources specialists at Hickam AFB were consulted (12-20-06) regarding the need for archaeological monitoring of ground disturbing activities in the HIANG area, and their position is that monitoring outside of the medium and high archaeological probability areas is not required (personal communication, Curtis 2006). The Standard Operating Procedures for Facilities Development, Archaeological Resources in the Hickam AFB Cultural Resources Management Plan (CRMP) (Hickam AFB n.d.) requires monitoring for areas of medium archaeological probability, and archaeological testing in areas of high archaeological probability (Hickam AFB n.d.). ***As explained in the EA,*** and outlined above, these requirements, along with the map of archaeological probability obtained from the cultural resources specialist at Hickam AFB, were included in the EA on pages 4-21 and 4-22, respectively.
Cultural Resources	State of Hawaii, Department of Land and Natural Resources	The commentor stated that the EA should include a systematic accounting of all historic structures within the APE, and an assessment of how they will be impacted (or not) by planned construction activities.	***Response:*** The EA contains an accounting of historic properties within the APE on page 3-38, and is illustrated in Figure 3.7-1 on page 3-37. The EA contains an assessment of how Battery Selfridge and Battery Jackson within the APE will not be impacted by planned construction activities in Section 4.7.1, page 4-24. ***EA Text Change:*** Sections 3.7 and 4.7 have been revised substantially due to the acquisition of new information regarding the NRHP eligibility of Cold War-era buildings in the ROI and completion of Section 106 consultation with SHPD.
Cultural Resources	State of Hawaii, Office of Hawaiian Affairs	The commentor noted that should Hickam AFB be selected for the replacement of F-15 aircraft with F-22A aircraft, Office of Hawaiian Affairs will rely on the assurances contained within the subject Draft EA that no environmental resources or known Native Hawaiian traditional, cultural, or burial sites will be adversely affected. Office of Hawaiian Affairs requests that in the event Native Hawaiian cultural, traditional, or burial sites are inadvertently discovered during ground disturbance, all work will immediately cease, and the appropriate agencies contacted pursuant to applicable laws.	***Refer to Section*** 4.7.1. As described in this section, as well as outlined in the Integrated CRMP, the HIANG will follow all applicable procedures and laws.

Table 2.4-3. Draft EA Public and Agency Comments (Page 8 of 8)

Resource	*Commentor*	*Summarized Comment*	*EA Section and Response to Comment*
Land Use	State of Hawaii, Department of Transportation	The commentor noted that neither the FAA or Hawaii Department of Transportation recognizes nor uses the Air Installation Compatible Use Zone (AICUZ) Program. Honolulu International Airport is an FAA Part 139 Certificated Airport and has 1,000 foot long runway safety areas plus 1,700 foot long runway protection zones beyond its runway ends as shown on our FAA approved Airport Layout Plan.	***EA Text Change:*** Page 3-42, Section 3.8.2.1, Modified 3rd paragraph and inserted 4 new paragraphs as follows: The Air Force CZ is an area 3,000 feet wide by 3,000 feet long for both Class A and Class B runways, and is located at the immediate end of the runway. For safety reasons, no construction is allowed and the military is authorized to purchase the land for these areas if not already part of the installation. The Air Force APZ I is less critical than the CZ, but still poses potential for accidents. This 3,000-foot wide by 5,000-foot long area located just beyond the CZ, has land use compatibility guidelines that allow a variety of industrial, utilities, and open space uses. Uses that concentrate people in small areas are not compatible. The Air Force APZ II is less critical than APZ I, but still poses potential for accidents. APZ II is 3,000 feet wide and extends 7,000 feet beyond APZ I. Compatible land uses include those of APZ I, as well as low-density single family residential, and commercial uses with low intensity or scale of operation. High density functions such as multi-story buildings and places of assembly (e.g., theaters, schools, and restaurants) are not considered compatible. Honolulu International Airport is a joint use facility and as such, the airport is an FAA Part 139 Certificated Airport and has 1,000-foot long runway safety plus areas plus 1,700-foot long runway protection zones at the end of its runway in an effort to limit development in those safety areas. These areas are depicted in the FAA's Airport Layout Plan.

2.6 Environmental Comparison of the Proposed Action and No Action Alternative

The following table compares the environmental consequences by resource associated with the proposed HIANG replacement of F-15 aircraft with F-22A aircraft. Table 2.6-1 summarizes the consequences of implementing the Proposed Action and includes the No Action Alternative. This summary is derived from the detailed analyses presented in Chapter 4.0 of this EA. Chapter 5.0 addresses cumulative consequences and finds that there are no significant cumulative environmental consequences resulting from an F-22A replacement decision when added to other past, present, or reasonably foreseeable future federal and non-federal actions.

This section summarizes potential environmental consequences and compares the proposed replacement of HIANG F-15 aircraft with F-22a aircraft with the No Action Alternative.

Table 2.6-1. Summary of Potential Consequences by Resource (Page 1 of 2)

EA Resource Section	*Proposed Action Replacement of F-15 with F-22A Aircraft*	*No Action Alternative*
Airspace Management	Daily operations increase by approximately 1.3 percent compared to existing conditions. Modified F-22A approach pattern being coordinated between HIANG and FAA. No substantive change in offshore Warning Area airspace.	Continued use of Hickam AFB and training airspace by F-15 aircraft.
Noise	The F-22A aircraft's more powerful engines results in greater noise on and off base. Noise contours dominated by commercial aircraft not expected to increase. Modified F-22A approach pattern expected to result in no change to off-base noise. Supersonic activities in overwater areas would not be expected to impact recreationists or sensitive species.	No change in aircraft and no construction. Noise would remain at baseline conditions on base and in Warning Areas.
Safety	New and improved HIANG facilities would incorporate current safety technology. Expanded F-22A safety arcs as compared with the F-15 would require an update of the Hickam AFB Explosive Safety Plan. Chaff use reduced by 2,318 bundles and flare use reduced by 784 units. Personnel and facilities able to handle chaff and flares. Bird-aircraft strike hazard (BASH) essentially unchanged. Class A accident potential risk expected to become comparable to similarly sized F-15 aircraft as F-22A system matures.	Continuation of current BASH, chaff and flare, and other safety conditions.
Air Quality	Honolulu area is in attainment for all criteria pollutants. Local air quality or visibility not significantly affected. No significant change projected to air quality within Honolulu or offshore Warning Areas. No conformity review is required.	No renovation or new construction and no change from current emissions.
Physical Resources	Renovation and construction in previously disturbed areas. NPDES and Stormwater Pollution Control Plan (SWPCP) would be followed (including implementation of BMPs) and updated. Low observability aircraft coatings require special treatment and facilities are proposed for construction. No significant effects on earth or water resources, hazardous materials, hazardous wastes, or Installation Restoration Program (IRP). Annual plastic debris from chaff and flares expected to be 0.6 to 13 pieces per square mile of overwater areas.	No ground-disturbing activities. Hazardous wastes would be generated at current levels. Chaff and flare debris deposited at current level of .25 to 5.8 pieces per square mile of overwater areas.
Biological Resources	No sensitive biological species affected. F-22A ability to rapidly climb above normal altitude of migrating waterfowl and other birds combined with more sorties should have no measurable change in BASH potential. Birds and marine mammals associated with the airspace not expected to be adversely affected by noise. Inert plastic chaff and flare debris not expected to impact marine mammals, although any plastic materials increase the amount of such material entering the food chain.	No change from existing conditions.

Table 2.6-1. Summary of Potential Consequences by Resource (Page 2 of 2)

EA Resource Section	*Proposed Action Replacement of F-15 with F-22A Aircraft*	*No Action Alternative*
Cultural Resources	None of the base buildings proposed for renovation or demolition meets the designation as an historic structure. Fort Kamehameha Historical District not affected. No Native Hawaiian cultural sites projected to be affected by construction or operations.	No change from existing conditions.
Land Use	Renovation and construction consistent with Base General Plan. Off-base area affected by 65 decibel (dB) noise contour essentially unchanged. Potential temporary increase in traffic congestion during construction. No noticeable change in traffic from existing with F-22A replacement.	No change to noise environment on-base and environs. No construction or personnel changes. No changes in traffic.
Socioeconomics	Total regional socioeconomic stimulation from $146.4 million renovation and construction estimated at $215 million in total output and 1,450 total jobs. Adequate construction workers are in the large urban Honolulu area. Equivalent on-base positions not projected to change from those currently supporting the F-15 squadron. Changes in aircraft could reallocate HIANG personnel assignments and full- or part-time status.	No change in HIANG personnel.
Environmental Justice	Minority and low income populations in the Honolulu area somewhat higher than those of the county. Difference not significant. No disproportionate impact upon minority or low income populations or upon children.	No change from existing conditions.

3.0 AFFECTED ENVIRONMENT ON HICKAM AIR FORCE BASE AND IN MILITARY OR OFFSHORE TRAINING AIRSPACE

This chapter contains the environment potentially affected by replacing F-15s with F-22As at Hickam AFB and training F-22As in offshore airspace. NEPA requires that the analysis address those areas and the components of the environment with the potential to be affected; locations and resources with no potential to be affected need not be analyzed.

Resource sections generally include resource attributes and any applicable regulations. The expected geographic scope of any potential consequences is identified as the Region of Influence (ROI). For most resources in this chapter, the on-base ROI is defined as the boundaries of Hickam AFB. For some resources (such as Noise, Air Quality, and Socioeconomics), the ROI extends over a larger jurisdiction unique to the resource. Offshore Warning Areas were considered for resources with the potential to be affected, including airspace, physical, and biological resources.

The *Existing Conditions* of each relevant environmental resource is described to give the public and agency decisionmakers a meaningful point from which they can compare potential future environmental, social, and economic effects. The *Environmental Consequences* for each resource are discussed in Chapter 4.0 and considers the direct and indirect effects of the Proposed Action described in Chapter 2.0, including the No Action Alternative. Cumulative effects are discussed in Chapter 5.0.

3.1 Airspace Management and Air Traffic Control

The affected environment for aircraft operations at Hickam AFB includes the base, the airspace associated with the base, and offshore Warning Areas used for training.

3.1.1 Definition of Resource

Airspace management involves the direction, control, and handling of flight operations in the volume of air that overlies the geopolitical borders of the U.S. and its territories. Airspace is a resource managed by the Federal Aviation Administration (FAA), with established policies, designations, and flight rules to protect aircraft in the airfield and en route; in Special Use Airspace (SUA) identified for military and other governmental activities; and in other military training airspace. Management of this resource considers how airspace is designated, used, and administered to best accommodate the individual and common needs of military, commercial, and general aviation. Because of these multiple and sometimes competing demands, the FAA considers all aviation airspace requirements in relation to airport operations, Federal Airways, Jet Routes, military flight training activities, and other special needs to determine how the National Airspace System can best be structured to satisfy all user requirements.

The FAA has designated four types of airspace above the U.S. They are Controlled, Special Use, Uncontrolled, and Other airspace and are defined in Appendix D.

3.1.2 Hickam AFB and Honolulu International Airport

Honolulu International Airport is a joint-use facility supporting both civil air traffic and military operations conducted by units stationed at Hickam AFB. Controlled airspace has been established around the airport to support managing air traffic. Class B controlled airspace extends in a semi-circle approximately 21 NM south of the airport. Within this airspace, closer to the airport (approximately 15 NM), Class E Controlled airspace underlies the Class B airspace (see Appendix D).

Air Traffic Control (ATC) for Honolulu International Airport is provided by the Honolulu Control Facility (HCF). The HCF consists of the Air Traffic Control Tower (ATCT) and HCF Approach. The function of the HCF Approach is to control all airspace surrounding Hawaii, except for the local ATCTs, and other SUA in the region (Mestre Grove Associates 2004).

C-5 aircraft are transients at Hickam AFB.

Several low-altitude Federal airways (Victor Routes) and high-altitude jet routes provide ingress and egress to Honolulu International Airport.

A variety of factors can influence the annual level of operational activity at an airfield, including maintenance, national emergencies, and economics. Three year's worth of annual operations data are presented in Table 3.1-1. Operations consist of arrivals and departures (itinerant) by air carrier, air taxi, general aviation, and military. Military operations have been between 4.5 to 5.3 percent of the total annual operations. Local operations are closed patterns around the airfield by General Aviation and military. These data were then used to calculate a geometric mean of specific activity levels. The geometric mean smoothes out large variances in data points. Both the arithmetic and geometric means are 5.0 percent of total operations.

Table 3.1-1. Annual Operations

	Operations Averages 2003 – 2005						
	Itinerant				*Local*		
	Air Carrier	*Air Taxi*	*General Aviation*	*Military*	*General Aviation*	*Military*	*Total*
2003	165,024	46,012	73,651	15,826	4,890	262	305,665
2004	174,903	57,677	66,439	16,825	4,155	276	320,275
2005	183,510	65,702	64,432	14,669	2,083	150	330,546
Arithmetic Mean	174,479	56,464	68,174	15,773	3,709	229	318,829
Geometric Mean	174,315	55,866	68,061	15,749	3,485	221	317,698

For the purpose of this analysis, all Hickam-based and transient military aircraft represent an annual average of 5 to 6 percent of the Honolulu-Hickam airfield operations.

3.1.3 Hawaii Operations Areas

F-15 training occurs in Hawaii offshore airspace Warning Areas and ATCAAs as presented on Figure 3.1-1.

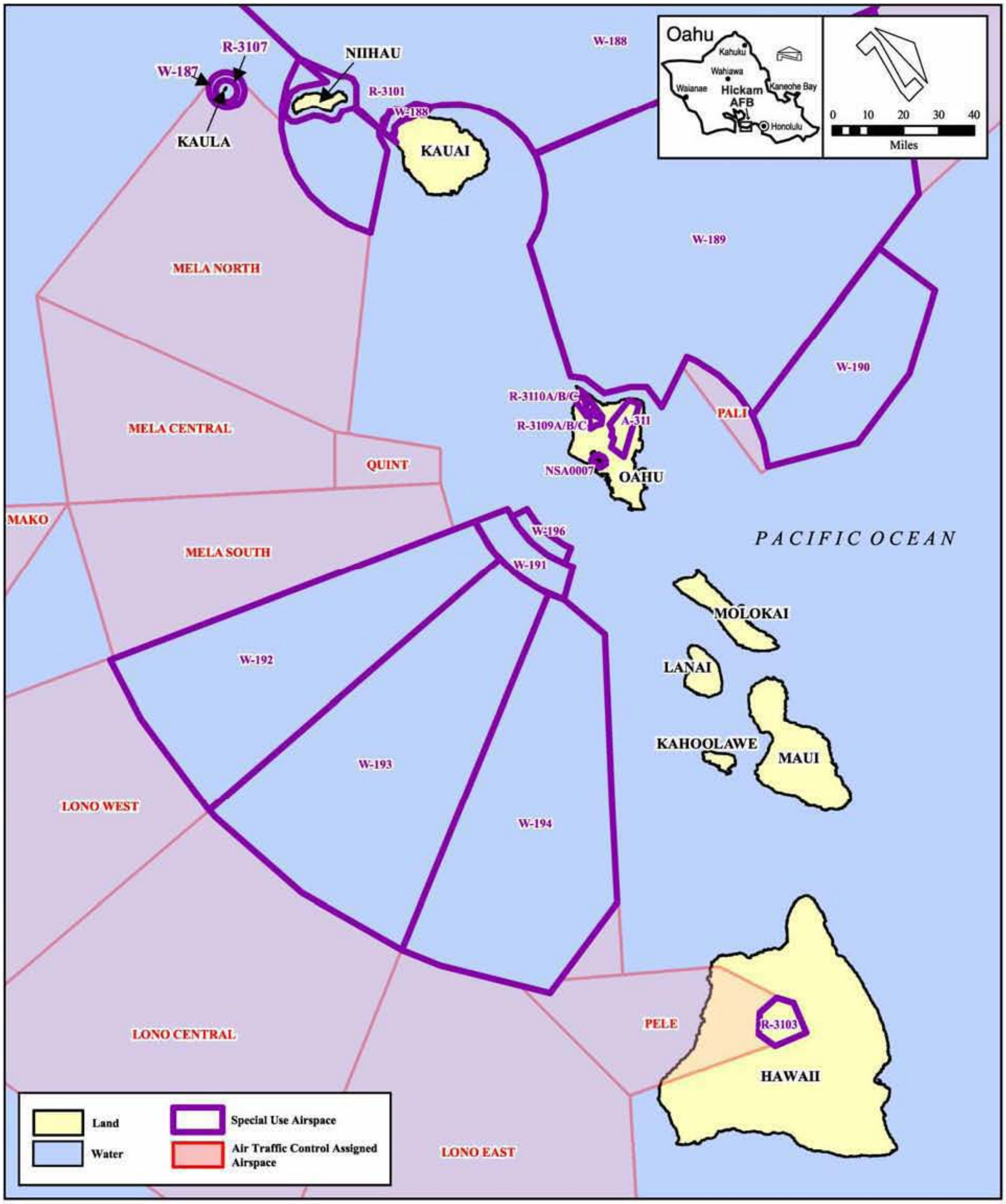


Figure 3.1-1. Special Use Airspace, Hickam AFB, Hawaii

Warning Areas are located north and south of the island of Oahu. These Warning Areas are described in Table 3.1-2. The Warning Areas listed in the table are all controlled by the HCF Approach. Those closest to Hickam AFB are to the south of the island. As noted in Section 2.5, F-15 aircraft currently train in these airspaces. The types of F-15 training activities are described in Table 2.3-1.

ATCAAs represent airspace controlled by the FAA ARTCC that are structured and used to extend airspace horizontally and/or in altitudes. Most of the ATCAAs currently used by F-15s and proposed for use by F-22s extend the Warning Areas further from the Hawaiian Islands.

Table 3.1-2. Description of Warning Areas

	Altitudes (feet)	
Warning Area	*Minimum*	*Maximum*
W-188	Surface	Unlimited
W-189	Surface	Unlimited
W-190	Surface	Unlimited
W-191	Surface	3,000 MSL[1]
W-192	Surface	Unlimited
W-193	Surface	Unlimited
W-194	Surface	Unlimited
W-196	Surface	2,000 MSL

Notes: 1. MSL = Feet above mean sea level
Source: U.S. Department of Transportation (DOT) FAA 2006

3.2 Noise

The ROI for the noise assessments is the area around Hickam AFB and surface areas underlying the military training airspace that are exposed to elevated noise levels caused by aviation-related noise and other human activities in the region.

3.2.1 Definition of Resource

Noise is considered to be unwanted sound that interferes with normal activities or otherwise diminishes the quality of the environment. It may be intermittent or continuous, steady or impulsive. It may be stationary or transient. Stationary sources are normally related to specific land uses, e.g., housing tracts or industrial plants. Transient noise sources move through the environment, either along relatively established paths (e.g., highways, railroads, and aircraft flight tracks around airports), or randomly. There is wide diversity in responses to noise that not only vary according to the type of noise and the characteristics of the sound source, but also according to the sensitivity and expectations of the receptor, the time of day, and the distance between the noise source (e.g., an aircraft) and the receptor (e.g., a person or animal).

The physical characteristics of noise, or sound, include its intensity, frequency, and duration. Sound is created by acoustic energy, which produces minute pressure waves that travel through a medium, like air or water, and are sensed by the ear drum. This may be likened to the ripples in water that would be produced when a stone is dropped into it. As the acoustic energy increases, the intensity or amplitude of these pressure waves increase and the ear senses louder noise. The unit used to measure the intensity of sound is the decibel (dB). Sound intensity varies widely (from a soft whisper to a jet engine) and is measured on a logarithmic scale to accommodate this wide range. The logarithm, and its use, is nothing more than a mathematical tool that simplifies dealing with very large and very small numbers. For example, the logarithm of the number 1,000,000 is 6, and the logarithm of the number 0.000001 is -6 (minus 6). Obviously, as more zeros are added before or after the decimal point, converting these numbers to their logarithms greatly simplifies calculations that use these numbers.

The frequency of sound is measured in cycles per second, or hertz (Hz). This measurement reflects the number of times per second the air vibrates from the acoustic energy. Low frequency sounds are heard as rumbles or roars, and high frequency sounds are heard as screeches. Sound measurement is further refined through the use of "A-weighting." The normal human ear can detect sounds that range in frequency from about 20 Hz to 15,000 Hz. However, all sounds throughout this range are not heard equally well. Therefore, through internal electronic circuitry, some sound meters are calibrated to emphasize frequencies in the 1,000 to 4,000 Hz range. The human ear is most sensitive to frequencies in this range, and sounds measured with these instruments are termed "A-weighted," and are shown in terms of A-weighted decibels (dBA).

Conversely, high amplitude impulsive noise events are experienced more as a "shock wave" of air overpressure. Explosions or sonic booms are examples of such noise events. These events are measured on a "C-weighted" scale, and are shown in terms of pounds per square foot of overpressure (psf), or C-weighted decibels (dBC).

The duration of a noise event, and the number of times noise events occur are also important considerations in assessing noise impacts.

As a basis for comparison when noise levels are considered, it is useful to note that at distances of about 3 feet, noise from normal human speech ranges from 63 to 65 dB, operating kitchen appliances range from about 83 to 88 dB, and rock bands approach 110 dB.

The word "metric" is used to describe a standard of measurement. As used in environmental noise analysis, there are many different types of noise metrics. Each metric has a different physical meaning or interpretation and each metric was developed by researchers attempting to represent the effects of environmental noise.

The metrics supporting the assessment of noise from aircraft operations around Hickam AFB and Honolulu International Airport, and construction activities associated with the proposals assessed in this document are the maximum sound level (L_{max}), the Sound Exposure Level (SEL), and Time-Averaged Sound Levels. Each metric represents a "tier" for quantifying the noise environment, and is briefly discussed below.

The L_{max} metric defines peak noise levels. L_{max} is the highest sound level measured during a single noise event (e.g., an aircraft overflight), and is the sound actually heard by a person on the ground. For an observer, the noise level starts at the ambient noise level, rises up to the maximum level as the aircraft flies closest to the observer, and returns to the ambient level as the aircraft recedes into the distance. L_{max} is important in judging a noise event's interference with conversation, sleep, or other common activities.

This document considers noise from aircraft operating around airfields. Around airfields, the primary operational modes of aircraft are departures (take-offs) and arrivals (landings). The following noise data pertaining to the F-15 and F-22A, as well as other aircraft (L_{max} and SEL) are presented for comparative purposes. Table 3.2-1 shows L_{max} values at various distances associated with typical military and civilian aircraft that currently operate at Hickam AFB and Honolulu International Airport and the proposed F-22A.

Table 3.2-1. Representative Maximum Sound Levels

Aircraft/Type Power	L_{MAX} Values (in dBA) at Varying Distances (in Feet)				
	500	***1,000***	***2,000***	***5,000***	***10,000***
Takeoff/Departure Operations					
F-15[1]	122.1	114.1	105.5	93.8	83.8
F-22A[2]	119.7	112.4	104.6	93.0	82.9
C-17	99.8	91.4	82.4	70.3	60.8
KC-135R	93.9	87.1	79.8	68.9	59.1
Boeing 737	110.7	104.0	96.7	85.8	76.3
Boeing 757	98.8	91.5	83.6	71.8	62.0
Landing/Arrival Operations					
F-15	88.5	81.6	74.3	63.2	53.4
F-22A	111.3	103.9	95.9	83.9	73.1
C-17	97.4	89.0	79.4	66.0	55.5
KC-135R	90.4	83.4	75.8	64.4	54.2
Boeing 737	84.5	77.3	69.7	58.3	48.4
Boeing 757	86.3	78.3	69.5	57.4	47.2

Notes: 1. For Take-off, F-15 is in Afterburner Mode (Most Common Departure).
2. For Take-off, F-22A uses Military Power (Most Common Departure).
Source: OMEGA108

L_{max} alone may not represent how intrusive an aircraft noise event is because it does not consider the length of time that the noise persists. The SEL metric combines intensity and duration into a single measure. It is important to note, however, that SEL does not directly represent the sound level heard at any given time, but rather provides a measure of the total exposure of the entire event. Its value represents all of the acoustic energy associated with the event, as though it was present for one second. Therefore, for sound events that last longer than one second, the SEL value will be higher than the L_{max} value. The SEL value is important because it is the value used to calculate other time-averaged noise metrics. Table 3.2-2 shows SEL values corresponding to the aircraft and power settings reflected in Table 3.2-1.

The number of times noise events occur during given periods is also an important consideration in assessing noise impacts. The "cumulative" noise metrics supporting the analysis of multiple time-varying noise events are the Day-Night Average Sound Level (L_{dn}), and the Equivalent Noise Level (L_{eq}).

Table 3.2-2. Representative Sound Exposure Levels

Aircraft/Type Power	SEL Values (in dBA) At Varying Distances (In Feet)				
	500	*1,000*	*2,000*	*5,000*	*10,000*
Takeoff/Departure Operations					
F-15[1]	125.1	118.9	112.2	102.8	94.6
F-22A[2]	124.2	118.7	112.7	103.5	95.2
C-17	108.2	102.4	96.2	87.3	79.8
KC-135R	97.2	92.2	86.7	78.2	70.2
Boeing 737	115.0	110.0	104.5	96.0	88.3
Boeing 757	102.5	97.0	90.9	81.5	73.5
Landing/Arrival Operations					
F-15	93.9	88.9	83.4	74.6	66.7
F-22A	114.9	109.3	103.1	93.5	84.5
C-17	103.0	96.5	88.7	77.7	69.0
KC-135R	96.0	90.8	85.0	76.0	67.6
Boeing 737	90.1	84.8	78.9	69.9	61.8
Boeing 757	91.3	85.0	78.1	68.3	60.0

Notes: 1. For Take-off, F-15 is in Afterburner Mode (Most Common Departure).
2. For Take-off, F-22A uses Military Power (Most Common Departure).
Source: OMEGA108

The L_{dn} metric sums the individual noise events and averages the resulting level over a specified length of time. Thus, it is a composite metric that considers the maximum noise levels, the duration of the events, the number of events that occur, and the time of day during which they occur. This metric adds 10 dB to those events that occur between 10:00 p.m. and 7:00 a.m. to account for the increased intrusiveness of noise events that occur at night when ambient noise levels are normally lower than during the day time. This cumulative metric does not represent the variations in the sound level heard. Nevertheless, it does provide an excellent measure for comparing environmental noise exposures when there are multiple noise events to be considered.

A sub-set of the L_{dn} metric is the Onset Rate-Adjusted Monthly Day-Night Average Noise Level (L_{dnmr}). To account for the random and often sporadic nature of military flight training activities in special use airspace, some of the computer programs developed by the Air Force to calculate noise levels created by these activities base their calculations on a monthly, rather than a daily, period. Additionally, to consider some of the unique aspects of noise created by low altitude, high-speed flight of military aircraft, up to 11 dBA may be added to the calculated noise levels to account for the rapid onset rate of the noise. Disregarding the onset-rate adjustment for a moment, it should be noted that arithmetically, calculations of L_{dnmr} will yield the same result as calculations of L_{dn}, as long as the numbers of sound events, or aircraft operations considered, are normalized to monthly as opposed to daily rates.

The L_{eq} metric too, sums all of the individual noise events and averages them over a specified time period. Common averaging times are 8- and 24-hour periods [$L_{eq(8)}$ and $L_{eq(24)}$]. This metric assigns no penalty for the time of the noise event. However, if no noise events occur at night, calculations of L_{dn} and $L_{eq(24)}$ would be identical.

Ambient background noise is not considered in the noise calculations that are presented below. There are two reasons for this. First, ambient background noise varies widely, depending on location and other conditions. For example, studies conducted in dense urban areas demonstrate exterior noise levels comparable to those on the periphery of airports. Conversely, a beach area can have high noise levels from natural causes, and a 10 dBA variance in sound levels simply due to an increase in wind velocity has been recorded (Harrison 1973). Therefore, assigning a value to background noise would be arbitrary. Secondly, and probably most important, is that it is reasonable to assume that ambient background noise in the project's ROI would have little or no effect on the calculated L_{dn}. In calculating noise levels, louder sounds dominate the calculations, and overall, aircraft and other transportation-related noise would be expected to be the dominant noise sources characterizing the acoustic conditions in the ROI.

Using measured sound levels as a basis, the Air Force developed several computer programs to calculate noise levels resulting from aircraft operations. Sound levels calculated by these programs have been extensively validated against measured data, and have been proven to be highly accurate.

In this document, the sound levels calculated for aircraft operations in an airfield environment are all daily L_{dn}. L_{dn} metrics are the preferred noise metrics of the Department of Housing and Urban Development, the DOT, the FAA, the U.S. Environmental Protection Agency (USEPA), and the Veteran's Administration.

L_{dn} may be thought of as the continuous or cumulative A-weighted sound level that would be present if all of the variations in sound level that occur over the given period were smoothed out so as to contain the same total sound energy. While L_{dn} does provide a single measure of overall noise impact, it is fully recognized that it does not provide specific information on the number of noise events or the specific individual sound levels which occur. For example, an L_{dn} of 65 dB could result from a very few noisy events, or a large number of quieter events. Although it does not represent the sound level heard at any one particular time, L_{dn} does represent the total sound exposure. Scientific studies and social surveys have found the L_{dn} to be the best measure to assess levels of community annoyance associated with all types of environmental noise. Therefore, its use is endorsed by the scientific community and governmental agencies (American National Standards Institute 1980, 1988; USEPA 1974; Federal Interagency Committee on Urban Noise 1980; Federal Interagency Committee on Noise 1992).

Additional technical information on the methodology and concept of aircraft noise measurement and modeling, as well as data on noise effects, can be found in Appendix E.

3.2.2 Hickam AFB and Honolulu International Airport

Public annoyance is the most common concern associated with exposure to elevated noise levels. When subjected to L_{dn} levels of 65 dBA, approximately 12 percent of the persons so exposed will be "highly annoyed" by the noise. At levels below 55 dBA, the percentage of annoyance is lower (less than 3 percent), and at levels above 70 dBA, it is higher (greater than 25 percent) (Finegold *et al.* 1994). Table 3.2-3 shows the percentage of the population expected to be highly annoyed at a range of noise levels.

Table 3.2-3. Percentage of Population Highly Annoyed By Elevated Noise Levels

Noise Exposure (L_{dn} in dBA)	*Percent Highly Annoyed*
< 65	< 12%
65 – 70	12% – 21%
70 – 75	22% – 36%
75 – 80	37% – 53%
80 – 85	54% – 70%
> 85	> 71%

Source: Finegold *et al.* 1994

The following terms are defined to provide a better understanding of how data are developed for input to the various noise models used to calculate noise.

Around an airfield, ***aircraft operations*** are categorized as take-offs, landings, or closed patterns (which could include activities referred to as touch-and-go's or low approaches). Each take-off or landing constitutes one operation. A ***closed pattern*** occurs when the pilot of the aircraft approaches the runway as though planning to land, but then applies power to the aircraft and continues to fly as though taking off again. The pilot then flies a circular or rectangular track around the airfield, and again approaches for landing. In some cases the pilot may actually land on the runway before applying power, or in other cases the pilot simply approaches very close to the ground. In either event, since a closed pattern operation essentially consists of a landing and a take-off, it is considered two operations.

Hickam AFB/Honolulu International Airport is located on the southern portion of the island of Oahu. Under current conditions, the airfield supports military and civil aviation activity, averaging approximately 317,700 aviation operations per year. This equates to approximately 880 daily operations. Considering all types of flight activities, a scenario representing an "average day's" operations was developed. The operations considered include arrivals (landings), departures (take-offs), and closed patterns. Noise calculations consider the frequency of flight operations, runway utilization, and the flight tracks and flight profiles flown by each aircraft. The numbers and types of representative operations considered are shown in Table 3.2-4.

Table 3.2-4. Average Daily Operations at Hickam AFB/ Honolulu International Airport[1]

Aircraft	Arrivals		Departures		Closed Patterns		Total
	Day	*Night*	*Day*	*Night*	*Day*	*Night*	
F-15	10.6	1.4	12.0	0.0	0.0	0.0	24.0
C-17	3.0	0.0	3.0	0.0	0.0	0.0	6.0
KC-135R	2.2	0.1	2.3	0.0	0.0	0.0	4.6
Transient Military	7.8	1.6	7.8	1.6	0.0	0.0	18.8
Civil	377.9	30.7	367.2	41.4	9.5	0.0	826.7
Total	401.5	33.8	392.3	43.0	9.5	0.0	880.1

Note: 1. Daily operations are based on averages of annual operations; therefore, numbers do not round.

These levels and types of activity are then combined with information on climatology, maintenance activities, and aircraft flight parameters, and processed through the Air Force's BASEOPS/NOISEMAP computer models to calculate L_{dn}. Once noise levels are calculated, they are plotted on a background map in 5-dB increments from 65 dBA to 85 dBA, as applicable. Baseline noise contours at Hickam AFB and Honolulu International Airport are shown in Figure 3.2-1. The land area on and off the airport (in acres) encompassed by each contour under baseline conditions is shown in Table 3.2-5.

Table 3.2-5. Land Area Exposed To Indicated Sound Levels Under Baseline Conditions

Noise Level (In L_{dn})	Baseline			
	Land Acres		Water Acres	
	Off-Installation[1]	*On-Installation*	*Off-Installation*	*On-Installation*
60 – 65	0		1,275	0
65 – 70	1,113	561	17,290	4
70 – 75	686	1,086	5,836	10
75 – 80	644	632	2,735	1
80 – 85	93	782	891	6
> 85	0	831	1	0
Total	2,536	3,892	28,028	21

Note: 1. Installation includes Hickam AFB and Honolulu International Airport.

Several locations (Points of Interest) in the area immediately off Hickam AFB were selected for specific analysis. These points of interest include schools (both public and private), churches, and areas where groups may assemble. These locations included a sampling of points in the ROI where land uses could be sensitive to elevated noise levels. Figure 3.2-1 presents these points of interest. Noise exposure at these points is shown in Table 3.2-6.

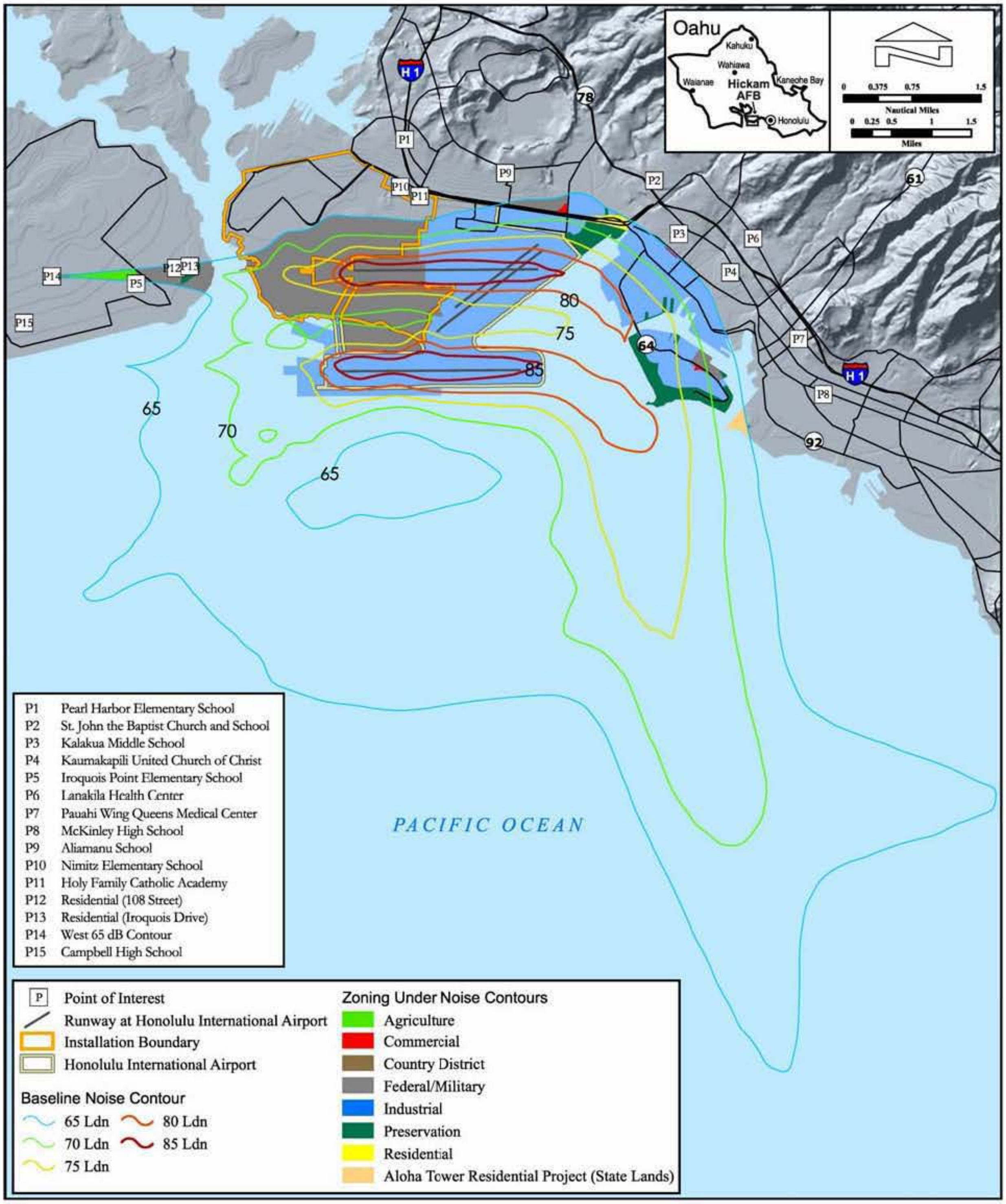


Figure 3.2-1. Baseline Noise Contours

Table 3.2-6. Specific Point Noise Exposure

Point ID	*Description*	*Exposure (in L_{dn})*
P1	Pearl Harbor Elementary School	55.2
P2	St. John the Baptist Church and School	58.7
P3	Kalakua Middle School	61.9
P4	Kaumakapili United Church of Christ	60.5
P5	Iroquois Point Elementary School	64.0
P6	Lanakila Health Center	55.8
P7	Pauahi Wing Queens Medical Center	57.5
P8	McKinley High School	57.1
P9	Aliamanu School	60.5
P10	Nimitz Elementary School	60.0
P11	Holy Family Catholic Academy	61.0
P12	Residential (108 Street)	68.1
P13	Residential (Iroquois Drive)	67.9
P14	West 65 dB Contour	65.0
P15	Campbell High School	53.3

These noise levels are all compatible with the indicated land uses.

In addition to aviation noise, some additional noise results from day-to-day activities associated with operations, maintenance, and the industrial functions associated with the operation of the airfield, and other commercial activities around the airport. These noise sources include the operation of ground-support equipment, and other transportation noise from vehicular traffic. However, this noise is generally localized in industrial areas on or near the airfield, or on established lines of communication supporting traffic to-and-from the airfield. Noise resulting from aircraft operations remains the dominant noise source in the airfield ROI.

3.2.3 Military Training Airspace

Currently, both subsonic and supersonic flight activities are conducted in the overwater Warning Areas and ATCAAs north and south of the island of Oahu.

3.2.3.1 Subsonic Flight

Within the Warning Areas and ATCAAs, subsonic flight is dispersed and usually occurs randomly. Section 2.3.1 describes the training use of Warning Areas and ATCAAs. The Air Force has developed the MR_NMAP (MOA-Range NOISEMAP) computer program (Lucas and Calamia 1996) to calculate subsonic aircraft noise in these areas. MR_NMAP can calculate noise for both random operations and operations channeled into corridors. Noise levels in this document reflect random operations, and are described as "uniformly distributed noise levels" throughout the airspace. Noise calculations consider the aircraft, the engine power settings, the altitude regimes in which the aircraft operates, the area encompassed by the airspace, and the amount of time the aircraft flies in the airspace.

Under current conditions, the most intensely-used training airspace is Warning Area W-189. An estimated 2,153 F-15 sortie-operations are conducted in W-189 annually. Calculations of military aircraft contributions to noise in W-189 reflect 34.4 L_{dnmr}. This level is at or below what would ordinarily be considered ambient. Some aircraft noise may be heard, but it would not be considered intrusive. Operations in all other Warning Areas or ATCAAs are considerably less.

3.2.3.2 Supersonic Flight

Supersonic flight for fighter aircraft is primarily associated with air combat training. Supersonic activity is authorized in the offshore Warning Areas. The amplitude of an individual sonic boom is measured by its peak overpressure, in psf and depends on an aircraft's size, weight, geometry, Mach number, and flight altitude. The Mach number is a multiple of the speed of sound. The actual speed of sound varies under differing atmospheric and environmental conditions, but, for any given condition, the speed of sound is identified as Mach 1.0. The biggest single condition influencing boom amplitude is altitude. Table 3.2-7 shows sonic boom overpressures for the F-15 aircraft in level flight at various altitudes, and relates these overpressures to a sound exposure level. Maneuvers can also affect boom peak overpressures, increasing or decreasing overpressures from those shown.

Table 3.2-7. Sonic Boom Peak Effects for F-15 Aircraft at Mach 1.2 Level Flight

Aircraft	**Altitude (In Feet)**			
	10,000	***20,000***	***30,000***	***40,000***
Overpressure (in psf)				
F-15	5.40	2.87	1.90	1.46
C-Weighted Sound Exposure Level[1]				
F-15	116.6	111.2	107.6	105.3

Note: 1. Calculated by: CSEL = 102 + (20 X log (psf)).

Aircraft exceeding Mach 1 always create a sonic boom, although not all supersonic flight activities will cause a boom at ground level. As altitude increases, air temperature decreases, and the resulting layers of temperature change cause booms to be turned upward as they travel toward the ground.

Depending on the altitude of the aircraft and the Mach number, many sonic booms are bent upward sufficiently that they never reach the ground. This same phenomenon, referred to as "cutoff," also acts to limit the width (area covered) of sonic booms that do reach the ground (Plotkin *et al*. 1989).

When a sonic boom reaches the ground, it impacts an area that is referred to as a "footprint" or (for sustained supersonic flight) a "carpet." The size of the footprint depends on the supersonic flight path and on atmospheric conditions. Sonic booms are loudest near the center of the footprint, with a sharp "bang-bang" sound. Near the edges, they are weak and have a rumbling sounding like distant thunder.

Sonic booms from air combat training activity have an elliptical pattern. Aircraft will set up at positions up to 100 NM apart, before proceeding toward each other for an engagement. The airspace used tends to be aligned, connecting the setup points in an elliptical shape. Aircraft will fly supersonic at various times during an engagement exercise. Supersonic events can occur as the aircraft accelerate toward each other, during dives in the engagement itself, and during disengagement.

A specific measure to quantify impulsive sonic boom overpressure is the C-weighted Day-Night Sound Level (CDNL). CDNL is a day-night average sound level computed for areas subject to sonic booms. These overwater areas are also subject to subsonic noise assessed according to L_{dnmr}. The long-term CDNL sonic boom patterns also tend to be elliptical.

3.3 Safety

3.3.1 Definition of Resource

This section addresses ground, flight, and explosive safety associated with activities conducted by the 199 FS stationed at Hickam AFB/Honolulu International Airport. Ground safety considers issues associated with human activities, and operations and maintenance activities that support unit operations. A specific aspect of ground safety addresses anti-terrorism/force protection (AT/FP) considerations. Flight safety considers aircraft flight risks such as aircraft accidents and bird aircraft strike hazards. Explosive safety discusses the management and use of ordnance and munitions.

The ROI for safety is Honolulu International Airport, the areas immediately adjacent to the airport, and the regional military training airspace supporting 199 FS operations.

3.3.2 Hickam AFB

3.3.2.1 Ground Safety

Day-to-day operations and maintenance activities conducted by the 199 FS are performed in accordance with applicable Air Force safety regulations, published Air Force Technical Orders, and standards prescribed by Air Force Occupational Safety and Health requirements.

The 199 FS, which is part of the 154 WG, has no independent fire and crash response responsibility. The airfield itself is a joint-use facility shared by the Air Force at Hickam AFB, and Honolulu International Airport. There are two state-controlled fire stations that support Honolulu International Airport. The Air Force has one station, with responsibility to respond to all military requirements. The Air Force fire department also responds to structure fires (personal communication, Compton 2003).

Current 199 FS facilities have all required fire protection infrastructure in place, and hangars are equipped with automatic fire suppression capability (personal communication, Compton 2003).

The Department of Defense (DoD) stipulates certain safety restrictions on land uses in the immediate vicinity of aviation operations around military airfields. On Hickam AFB, all Clear Zones (CZs), Object Free Zones, and transitional surfaces bounding aircraft flight lines meet all requirements (personal communication, Compton 2003).

As a result of terrorist activities, the DoD and the Air Force have developed a series of AT/FP guidelines for military installations. These guidelines address a range of considerations that include access to the installation, access to facilities on the installation, facility siting, exterior design, interior infrastructure design, and landscaping (Unified Facilities Criteria [UFC] 2003). The intent of this siting and design guidance is to improve security, minimize fatalities, and limit damage to facilities in the event of a terrorist attack.

Many military installations, such as the 199 FS facilities, were developed before such considerations became a critical concern. Thus, under current conditions, many units are not able to comply with all present AT/FP standards. However, as new construction occurs, it would take these standards into consideration in facility location and design. As facilities are modified, AT/FP standards would be incorporated to the maximum extent practicable.

3.3.3 Hickam AFB and Regional Military Training Airspace

3.3.3.1 Flight Safety

The primary public concern with regard to flight safety is the potential for aircraft accidents. Such mishaps may occur as a result of mid-air collisions, collisions with manmade structures or terrain, weather-related accidents, mechanical failure, pilot error, or bird-aircraft collisions. Flight risks apply to all aircraft; they are not limited to the military. Flight safety considerations addressed include aircraft mishaps and wildlife-aircraft strikes.

Aircraft Mishaps. The Air Force defines four major categories of aircraft mishaps: Classes A, B, C, and E, which includes High Accident Potential (HAP). Class A mishaps result in a loss of life, permanent total disability, a total cost in excess of $1 million, or destruction of an aircraft. Class B mishaps result in total costs of more than $200,000, but less than $1 million, result in permanent partial disability or inpatient hospitalization of three or more personnel. Class C mishaps involve reportable damage of more than $20,000, but less than $200,000; an injury resulting in any loss of time from work beyond the day or shift on which it occurred, or occupational illness that causes loss of time from work at any time; or an occupational injury or illness resulting in permanent change of job. HAP events are any hazardous occurrence that has a high potential for becoming a mishap. Class C mishaps and HAP, the most common types of accidents, represent relatively unimportant incidents because they generally involve minor damage and injuries, and rarely affect property or the public (Air Force 2004). This EA will focus on Class A mishaps because of their potentially catastrophic results.

Secondary effects of an aircraft crash include the potential for fire and environmental contamination. Again, because the extent of these secondary effects is situationally dependent, they are difficult to quantify. The terrain overflown in the ROI is primarily water. Should a mishap occur over land, highly vegetated areas during hot, dry weather would have a higher risk of experiencing extensive fires than would more barren and rocky areas during a wet season. An aircraft crash may release hydrocarbons. Those petroleums, oils, and lubricants not consumed in a fire could contaminate soil and water. The potential for contamination is dependent on several factors. The porosity of the surface soils will determine how rapidly contaminants are absorbed. The specific geologic structure in the region will determine the extent and direction of the contamination plume. The locations and characteristics of surface and groundwater in the area will also affect the extent of contamination to those resources. Over water, levels and concentrations of bio-organisms could determine the severity of impacts.

Based on historical data on mishaps at all installations, and under all conditions of flight, the military services calculate Class A mishap rates per 100,000 flying hours for each type of aircraft in the inventory. It should be noted that these mishap rates do not consider combat losses due to enemy action. In evaluating this information, it should be emphasized that data presented are only statistically predictive. The actual causes of mishaps are due to many factors, not simply the amount of flying time of the aircraft.

Since entering the Air Force inventory in 1979, F-15 aircraft have flown approximately 2,194,270 hours. During this time, F-15 aircraft have experienced 54 Class A mishaps. These data reflect a Class A mishap rate per 100,000 flying hours of 2.46 (Air Force Safety Center 2006).

It is estimated that the 199 FS flies approximately 3,600 hours in the ROI per year. Considering the mishap rate of 2.46 per 100,000 hours, the probability of an F-15 aircraft being involved in a Class A mishap is 0.000031, or one such mishap every 11.3 years.

Wildlife-Aircraft Strike Hazards. Bird-aircraft strikes constitute a safety concern because of the potential for damage to aircraft or injury to aircrews or local populations if an aircraft crash should occur in a populated area. Although aircraft may encounter birds at altitudes of 30,000 feet MSL or higher, most birds fly close to the ground. Over 97 percent of reported bird strikes occur below 3,000 feet above ground level (AGL). Approximately 30 percent of bird strikes happen in the airport environment, and almost 55 percent occur during low-altitude flight training (Air Force Safety Center 2002). Neither the F-15 nor the F-22A would train for low-altitude navigation.

Large waterfowl (e.g., ducks, egrets, and gulls) are hazardous to low-flying aircraft because of their size and their propensity for migrating in large flocks at a variety of elevations and times of day. Waterfowl vary considerably in size, with most species likely to be encountered at Hickam in the 1 to 4-pound category.

Shorebirds, gulls, herons, and songbirds post a hazard. Songbirds are small birds, usually less than one pound. The potential for bird-aircraft strikes with shorebirds or gulls is greatest in areas where birds congregate for foraging or resting (e.g., open water bodies, rivers, and wetlands).

While any bird-aircraft strike has the potential to be serious, many result in little or no damage to the aircraft, and only a minute portion result in a Class A mishap. During the years 1985 to 2001, the Air Force BASH Team documented 48,522 bird strikes. Of these, 20 resulted in Class A mishaps where the aircraft was destroyed. These occurrences constituted approximately 0.04 percent of all reported bird-aircraft strikes (Air Force Safety Center 2002).

A bird aircraft strike hazard exists in the Hawaiian Islands due to both resident and migratory species. Honolulu International Airport and Hickam AFB share an airfield and management challenges associated with any coastal airfield supporting myriad shorebirds finding habitat on beaches, marine wetlands, shallow open waters, and grassy areas around runways. Normally, the daily and seasonal bird movements create very little hazard to aircrews operating at Hickam AFB. However, occasionally concentrations do occur that elevate the hazard. There have been 94 bird aircraft strike hazard incidents at Honolulu during the period January 1989 - April 1997. 79 percent of these were reported by pilots. Some bird aircraft strike hazard incidents of note include: a black-necked stilt carcass found along a runway in 1993; and a black-crowned heron carcass found in 1996. Barn owls make up 14 percent of the 94 documented mishaps; doves make up 11 percent and Pacific golden plovers make up 9 percent. The most significant incident to date was a Philippine Airline 747 that ingested a bird into engine number two on take-off in 1991. Circumstantial evidence (white feathers) suggested the bird involved was a cattle egret. Airfields with wetlands seem to provide quality habitat for egrets. Egrets are now heavily managed for bird aircraft strike hazard because they are so common and can have large populations. Bird aircraft strike hazard risk associated with egrets has been considerably reduced. Nevertheless, some concentrations of egrets still occur in grassy areas along runways and on the approach to Runway 8L. Runway 8L/26R is of particular concern because this runway crosses the most shorebird habitat. Mangrove stands to the west and on an island in Keehi Lagoon east of the reef runway provide cover nesting and feeding habitat for songbirds. Cattle egrets and black-crowned night herons find suitable roosting habitat in these areas as well (USDA 1997, 15th Airlift Wing [15 AW] 2003). Risk also increases during the seasonal migrations of the Pacific golden plover. Between late August and late April, this bird is the most abundant on the airfield. Soaring frigate birds are occasionally seen at traffic pattern altitudes.

The 15 AW Base Civil Engineer provides habitat and terrain control to discourage nesting and gathering of birds. Habitat and terrain controls include mowing for specific vegetation heights, brush and tree removal, and dewatering and netting small ponds near runways. Other control processes and procedures are contracted to the U.S. Department of Agriculture, Animal Plant Health Inspection Service – Wildlife Services. During periods of high bird concentrations, flying activities are reduced or totally curtailed until the risk is reduced (15 AW 2003).

3.3.3.2 Chaff, Flares, and Explosives Safety

During training, aircraft are not loaded with any ordnance configured with high explosive warheads. The only exceptions would be for live air-to-air training at the Pacific Missile Range or mission related air-to-air ordnance for Hawaiian Island defense.

Ordnance are handled and stored in accordance with Air Force explosive safety directives (AFI 91-201), and all maintenance is carried out by trained, qualified personnel using Air Force-approved technical procedures. Overall responsibility for explosives safety rests with the Air Force at Hickam AFB (personal communication, Compton 2003).

Air-to-air missiles, chaff, and flares are stored in 154 WG igloos. These facilities are fully licensed for the explosives stored, and the types and amount of explosives stored are within allowable levels. However, the location of the existing facilities imposes safety constraints on other uses along the flight line and several waivers are in effect for functions that have no reasonable alternative site.

When an aircraft is configured for a mission, any ordnance mounted on the aircraft is in a "safe" configuration. Just prior to take-off, the physical safeguards on the ordnance must be removed, and after landing, if ordnance is still present, these safeguards must be reinstalled. This process is termed "arming/de-arming." Currently, there is no specific "arm/de-arm pad" available for use by the 154 WG. The taxiway leading to the runway must be used for these operations, which constrains other activities in the area when the arm/de-arm process occurs (personal communication, Compton 2003).

If necessary, explosive ordnance disposal (EOD) technicians are available on Hickam AFB and would support 199 FS requirements. System malfunctions or material failures could result in either an accidental release of ordnance or the release of a dud component that fails to operate properly. Studies have shown that the probability of such an accidental release occurring, the probability of it occurring where person or property could be affected, and the possibility of injury to a person or damage to property on the ground is so infinitesimally small that the risk associated with the occurrence can be essentially discounted (Air Combat Command 1997).

The HIANG F-15 training in Hawaii airspace uses defensive chaff and flares. Chaff and flares are authorized for use in the training airspace. Use is governed by detailed operating procedures to ensure safety. Chaff is small fibers of aluminum-coated mica packed into approximately 4-ounce bundles. Chaff is ejected from an aircraft to reflect radar signals. When ejected, chaff forms a brief electronic "cloud" that temporarily masks the aircraft from radar detection. Although the chaff may be ejected from the aircraft using a small pyrotechnic charge, the chaff itself is not explosive (Air Force 1997). Under current conditions, the 199 FS expended 12,768 bundles of chaff in the training airspace. Appendix A provides additional information on defensive chaff.

Defensive flares consist of small pellets of highly flammable material that burn rapidly at extremely high temperatures. Their purpose is to provide a heat source other than the aircraft's engine exhaust to mislead heat-sensitive or heat-seeking targeting systems and decoy them away from the aircraft. The flare, essentially a pellet of magnesium, ignites upon ejection from the aircraft and burns completely within approximately 3.5 to 5 seconds, or approximately 325 feet from its release point (Air Force 1997). Under current conditions, the 199 FS expended 6,384 flares in the training airspace. Appendix B provides additional information on defensive flares.

3.4 Air Quality

This section discusses air quality considerations and conditions in the area around Hickam AFB. The ROI is Honolulu County, island of Oahu. This section addresses air quality standards and describes current air quality conditions in the region.

3.4.1 Definition of Resource

Federal Air Quality Standards. Air quality is determined by the type and concentration of pollutants in the atmosphere, the size and topography of the air basin, and local and regional meteorological influences. The significance of a pollutant concentration in a region or geographical area is determined by comparing it to federal and/or state ambient air quality standards. Under the authority of the CAA, the USEPA has established nationwide air quality standards to protect public health and welfare, with an adequate margin of safety. These federal standards, known as the National Ambient Air Quality Standards (NAAQS), represent the maximum allowable atmospheric concentrations and were developed for seven "criteria" pollutants: ozone (O_3), nitrogen dioxide (NO_2), carbon monoxide (CO), sulfur dioxide (SO_2), particulate matter less than 10 microns in diameter (PM_{10}), particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), and lead (Pb). The NAAQS are defined in terms of concentration (e.g., parts per million [ppm] or micrograms per cubic meter [$\mu g/m^3$]) determined over various periods of time (averaging periods). Short-term standards (24-hour periods or less) were established for pollutants with acute health effects and may not be exceeded more than once a year. Long-term standards (annual periods) were established for pollutants with chronic health effects and may never be exceeded.

Based on measured ambient criteria pollutant data, the USEPA designates areas of the U.S. as having air quality equal to or better than the NAAQS (attainment) or worse than the NAAQS (nonattainment). Upon achieving attainment, areas are considered to be in maintenance status for a period of 10 or more years. Areas are designated as unclassifiable for a pollutant when there is insufficient ambient air quality data for the USEPA to form a basis for an attainment designation. For the purpose of applying air quality regulations, unclassifiable areas are treated similar to areas that are in attainment of the NAAQS.

State Air Quality Standards. Under the CAA, state and local agencies may establish ambient air quality standards (AAQS) and regulations of their own, provided these are at least as stringent as the federal requirements. The State of Hawaii Department of Health has adopted standards that are the same as the NAAQS, with the exceptions of CO and NO_2, which have more stringent standards. They have also promulgated a state standard for hydrogen sulfide (H_2S), for which there is no national standard. Table 3.4-1 summarizes the federal and state AAQS.

TABLE 3.4-1. HAWAII AND FEDERAL AMBIENT AIR QUALITY STANDARDS

Air Pollutant	*Averaging Time*	*Hawaii AAQS*	FEDERAL (NAAQS)	
			Primary	*Secondary*
Carbon Monoxide (CO)	8-hour 1-hour	4.4 ppm 9 ppm	9 ppm 35 ppm	--- ---
Nitrogen Dioxide (NO_2)	AAM	0.04 ppm	0.053 ppm	0.053 ppm
Sulfur Dioxide (SO_2)	AAM 24-hour 3-hour	0.03 ppm 0.14 ppm 0.50 ppm	0.03 ppm 0.14 ppm ---	--- --- 0.50 ppm
Particulate Matter (PM_{10})	24-hr AAM	150 $\mu g/m^3$ 50 $\mu g/m^3$	150 $\mu g/m^3$	150 $\mu g/m^3$
Particulate Matter ($PM_{2.5}$)	AAM 24-hour	--- ---	15 $\mu g/m^3$ 35 $\mu g/m^3$	15 $\mu g/m^3$ 35 $\mu g/m^3$
Hydrogen sulfide (H_2S)	1-hour	25 ppb	---	---
Ozone (O_3)	8-hour	0.08 ppm	0.08 ppm	---
Lead (Pb) and Lead Compounds	Calendar Quarter	1.5 $\mu g/m^3$	1.5 $\mu g/m^3$	1.5 $\mu g/m^3$

AAM = Annual Arithmetic Mean; ppm = parts per million; ppb = parts per billion; $\mu g/m^3$ = micrograms per cubic meter.
Source: 40 Code of Federal Regulations 50; Hawaii Administrative Rules (HAR), Chapter 59

State Implementation Plan. The CAA of 1977 set provisions for the attainment and maintenance of the NAAQS. The CAA Amendments of 1990 established federal nonattainment classifications, emission control requirements, and compliance dates for nonattainment areas. The requirements and compliance dates are based on the severity of nonattainment classification. For nonattainment regions, individual states are required to establish a State Implementation Plan (SIP) designed to eliminate or reduce the severity and number of NAAQS violations, with an underlying goal to bring state air quality conditions into compliance with the NAAQS by specific deadlines.

Prevention of Significant Deterioration. Section 162 of the CAA further established the goal of prevention of significant deterioration (PSD) of air quality in all international parks; national parks that exceeded 6,000 acres; and national wilderness areas and memorial parks that exceeded 5,000 acres if these areas were in existence on August 7, 1977. These areas were defined as mandatory Class I areas, while all other attainment or unclassified areas were defined as Class II areas. PSD Class I areas are areas where any appreciable deterioration of air quality is considered significant. Class II areas are those where moderate, well-controlled growth could be permitted. The PSD requirements affect construction of new major stationary sources in attainment or unclassified areas and are a pre-construction permitting system. The nearest PSD Class I area to the project region is the Haleakala National Park, which is approximately 120 miles to the east-southeast of Hickam AFB, on the island of Maui.

Visibility. CAA Section 169A established the additional goal of prevention of further visibility impairment in PSD Class I areas. Visibility impairment is defined as a reduction in the visual range and atmospheric discoloration. Determination of the significance of an activity on visibility in a PSD Class I area is typically associated with evaluation of stationary source contributions. The USEPA is implementing a Regional Haze rule for PSD Class I areas that will address contributions from mobile sources and pollution transported from other states or regions. Emission levels are used to qualitatively assess potential impairment to visibility in PSD Class I areas.

Stationary Sources Operating Permits. Title V of the CAA Amendments of 1990 also requires states to issue Federal Operating Permits for major stationary sources. Under the Hawaii Administrative Rules (HAR) (HAR §11-60.1-1) a major stationary source is defined as a source that emits equal to or more than 100 tons per year (TPY) of any one criteria air pollutant, 10 TPY of a hazardous air pollutant, or 25 TPY of any combination of hazardous air pollutants. The purpose of the permitting rule is to establish regulatory control over large, industrial activities and to monitor their impact upon air quality.

3.4.2 Regional Air Quality

Climate. Average temperatures in the City of Honolulu generally range from the lower 70s (degrees Fahrenheit [ºF]) in the winter months to lower 80s (ºF) in the summer months. Honolulu is on the island of Oahu, so the Pacific Ocean has a moderating affect on both seasonal and diurnal temperature ranges. The average high and low temperatures in January, the coolest month, are only 8 degrees cooler than the average high and low temperatures in August, the warmest month. The highest and lowest temperatures recorded between 1949 and 2005 were 95 (ºF) and 52 (ºF) respectively, which further illustrate the moderating effect that the Pacific Ocean provides to regional temperatures (Western Regional Climate Center [WRCC] 2006a).

Average annual precipitation for Honolulu is 20.86 inches. Honolulu generally experiences a wet winter and relatively dry summer with a monthly maximum of 3.34 inches in January, and a minimum of 0.37 inches in June (WRCC 2006a).

The island of Oahu is subject to trade winds. For each month of the year, Honolulu's average wind speed is at least 8.9 miles per hour (mph) and the annual average wind speed is 10.8 mph. The summer months tend to experience stronger trade winds. The prevailing wind direction is from the east northeast with very little variability from month to month. However, local topography, and the passage of storm fronts can greatly influence wind speed and direction on a short-term basis (WRCC 2006b, 2006c).

Regional Air Quality. Honolulu County, according to 40 CFR 81.76, is designated as part of the State of Hawaii Air Quality Control Region (AQCR) (AQCR 60). A review of federally published attainment status for AQCR 60 in 40 CFR 81.312 indicated that this region is designated as attainment (i.e., meeting national standards) for all criteria pollutants.

Current Air Emissions. Air emissions at the Hickam AFB in Honolulu are from stationary and mobile sources. Stationary sources include boilers, internal combustion engines, aircraft engine test operations while engines are on a test stand, incinerators, tank truck loading racks, and organic solvent cleaning units (Air Force Institute for Environment, Safety, and Health Risk Analysis [AFIERA] 2003). The mobile sources include aircraft operations and aircraft engine testing while the engines are attached to the aircraft. Table 3.4-2 summarizes annual emissions at Hickam AFB.

Table 3.4-2. Baseline Emissions for Hickam AFB

	Annual Emissions (tons per year)					
	VOC	*CO*	*NO_x*	*SO_x*	*PM_{10}*	*$PM_{2.5}$*
Stationary (Permitted) Sources[1]	2.43	1.33	1.04	0.28	0.11	N/A[2]
Mobile Sources						
Aircraft Operational Emissions[3]	12.53	52.64	26.81	1.06	4.75	4.70
Aircraft Engine Testing (on Aircraft)[4]	1.01	14.52	46.50	3.29	4.02	3.99
Total	15.97	68.49	74.35	4.63	8.88	8.69

Notes:
1. Source: AFIERA 2003.
2. PM2.5 not included in emissions inventory.
3. Calculated using emissions factors from the AFIERA, Air Emissions Inventory Guidance Document for Mobile Sources at Air Force Installations (2003a). See Appendix F for further details.
4. Calculated using same emissions factors as mentioned in note #2, and default annual number of tests and time in mode per test from the Air Force Air Conformity Applicability Model (ACAM) (Air Force Center for Environmental Excellence [AFCEE] 2005). See Appendix F for further details.

3.5 Natural Resources - Physical Resources

3.5.1 Definition of Resource

Physical resources include a description of earth (topography, geology, and soils), water, and hazardous material and waste. Topography characterizes surface form of the landscape and provides a description of the physical setting. Geologic resources include subsurface and exposed rock. The inherent properties of Hawaiian volcanic bedrock affect soil formation and properties, groundwater sources and availability, and terrain. Soils include particulate unconsolidated materials formed from in place the underlying volcanic bedrock or other parent material or transported from distant sources via wind and water. Soils play a critical role in the natural and human environment, affecting vegetation and habitat, water and air quality, and the success of the construction and stability of roads, buildings, and shallow excavations. Water resources include surface water, such as lakes, rivers, streams and wetlands and groundwater (subsurface hydrologic resources). On Oahu, these resources have scientific, historical, economic, ecological and recreational value.

Typically, issues relevant to water resources include the quality and quantity of water bodies which may be affected by construction or operations. Potential impacts to wetlands or hazards associated with 100-year floodplains delineated in accordance with Executive Order (EO) 11988, *Floodplain Management*. EO 11988, *Floodplain Management*, require federal agencies to take action to reduce the risk of flood damage; minimize the impacts of floods on human safety, health, and welfare; and to restore and preserve the natural and beneficial values served by floodplains. Federal agencies are directed to consider the proximity of their actions to or within floodplains. For discussion of wetlands as ecosystem components, see Section 3.6, Natural Resources-Biological Resources.

Hazardous materials are identified and regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); the Occupational Safety and Health Administration (OSHA); and the Emergency Planning and Community Right-to-Know Act (EPCRA). Hazardous materials have been defined in AFI 32-7086, *Hazardous Materials Management*, to include any substance with special characteristics which could harm people, plants, or animals. Hazardous waste is defined in the Resource Conservation and Recovery Act (RCRA) as any solid, liquid, contained gaseous or semisolid waste, or any combination of wastes which could or do pose a substantial hazard to human health or the environment.

Waste may be classified as hazardous due to of its toxicity, reactivity, ignitibility, or corrosivity. In addition, certain types of waste are "listed" or identified as hazardous in 40 CFR 263.

3.5.2 Hickam AFB

3.5.2.1 Earth Resources

Hickam AFB is located on the southern shores of Oahu, an island formed by volcanic activity. The southern coast of Oahu is a coastal plain with elevations ranging from 0 to 20 feet above sea level formed by a succession of marine sedimentary and terrestrial alluvial layers that formed during subsidence of the island and fluctuating sea levels (Air Force 2003).

Hickam AFB is located on a flat coastal plain on the southern shores of Oahu.

The primary soils found at Hickam AFB are Lualualei, fill land, and Ewa association. Lualualei soils make up about 20 percent of the association, fill land about 20 percent, and Ewa soils 15 percent. Honouliuli, Jaucas, Kawaihapai, Makalapa, Mamala, and Pulehu soils make up the rest (U.S. Department of Agriculture [USDA] 1971).

3.5.2.2 Water Resources

Section 404 of the Clean Water Act established a program to regulate the discharge of dredged or fill material into waters of the United States. The Rivers and Harbors Act of 1899 defined navigable waters of the United States as "those waters that are subject to the ebb and flow of the tides and/or are presently used, or have been used in the past, or may be susceptible to use to transport interstate or foreign commerce." This includes Hickam Harbor and the canals on base.

Hickam AFB has several man-made canals and underground storm drains that run from the base to Mamala Bay. The canals serve to transport stormwater and irrigation runoff to the ocean. Conditions in the Kumumauu and Manuwai Canals may be impacted by hazardous substances (HIANG 2003). Signs are posted warning against fishing and consuming fish from the canals.

mamala Bay is an important water resource offshore of Honolulu and Hickam AFB.

Groundwater is the principal source of potable water on Oahu although the salinity can be an issue. There is greater potential of saltwater intrusion of the aquifers closer to the coast. Water is transmitted to Hickam AFB through 30-inch transmission mains from three Navy-owned stations: Waiawa, Red Hill, and Halawa (HIANG 2003). There is an additional connection with the city and county, although the intention would be to use it only for emergency purposes; it has not been used for over ten years and is not accessible due to overgrown vegetation and obstacles. Hickam AFB water system has two storage reservoirs with 6 million gallons each (Booz Allen Hamilton 2006).

Waste water management and discharge permitting at Hickam AFB is accomplished through several NPDES permits administered by the State of Hawaii Department of Health. The most significant of which is the Fort Kamehameha NPDES permit for treated water outfall offshore. Naval Facilities Engineering Command, Hawaii (NAVFAC HI) has regulatory oversight for permitting. Hickam AFB discharges its wastewater to the Fort Kamehameha Wastewater Treatment Plant (WWTP) for proper sanitation. The collected wastewater is transported through gravity and pressure collection systems. The Fort Kamehameha WWTP has a capacity of 13 million gallons per day (MGD); Hickam AFB flows average an estimated 4.1 MGD. The treatment plant uses sand filtration and ultraviolet disinfection before discharging the wastewater into the Mamala Bay (Booz Allen Hamilton 2006). A 2006 NPDES compliance evaluation inspection report provides a summary of base non-domestic sources that either discharge to Fort Kamehameha WWTP through sewers or have zero-discharging wastewater systems. Ten of these sources are HIANG facilities. These internal sources to the base sewer system are permitted through a joint Hickam AFB and NAVFAC HI program. Hickam's careful oversight and management have limited unintentional wastewater releases in most cases. A separate NPDES permit covers stormwater run-off and the base storm sewer system, as well as dewatering.

In April 2006, high rainfall and flooding resulted in an overwhelming of storm sewer capacity near HIANG leasehold properties and discharge of contaminants from HIANG facilities on Hickam AFB into Mamala Bay (personal communication, Beltran 2006). This occurred during a time when high water volume and power outages overwhelmed sewage system capacity in portions of Honolulu with a resultant closure of Waikiki beaches. The USEPA found that Hickam operates a very effective and thorough sewer use permit process and has imposed some source control practices to limit inadvertent, incompatible, or uncontrolled releases. One area of potential improvement would be through consolidation of oil/water separators and sewer entry points and instituting "dry flow" practices throughout the base.

The project construction area under the Proposed Action occurs within area identified by the Federal Emergency Management Agency as a 100-year return period flood hazard zone. This area is not considered a floodplain (a typically riverine feature) but rather a zone with the potential for flooding that could result from a major storm event. Figure 3.5-1 shows the 100-year floodplain boundary. The potential flood inundation zone characterizes the area that would be inundated during a tsunami event. This zone is located between Reef Runway Lagoon and Motor Pool Canal (Air Force 2002).

Hickam AFB occurs within Hawaii's Coastal Zone Management Area (refer to Section 3.8) and has been a significant collaborator in the development of Hawaii's Coastal Nonpoint Pollution Control Program. In addition Hickam AFB has been managed to prevent coastal erosion and been a responsible steward of nearby coral reefs. Because Hickam AFB is adjacent to sensitive and valuable marine environments, a well-conceived, implemented, and maintained stormwater management program is critical to prevent base discharge from depositing silt, petroleum and other contaminants, and debris in Mamala Bay.

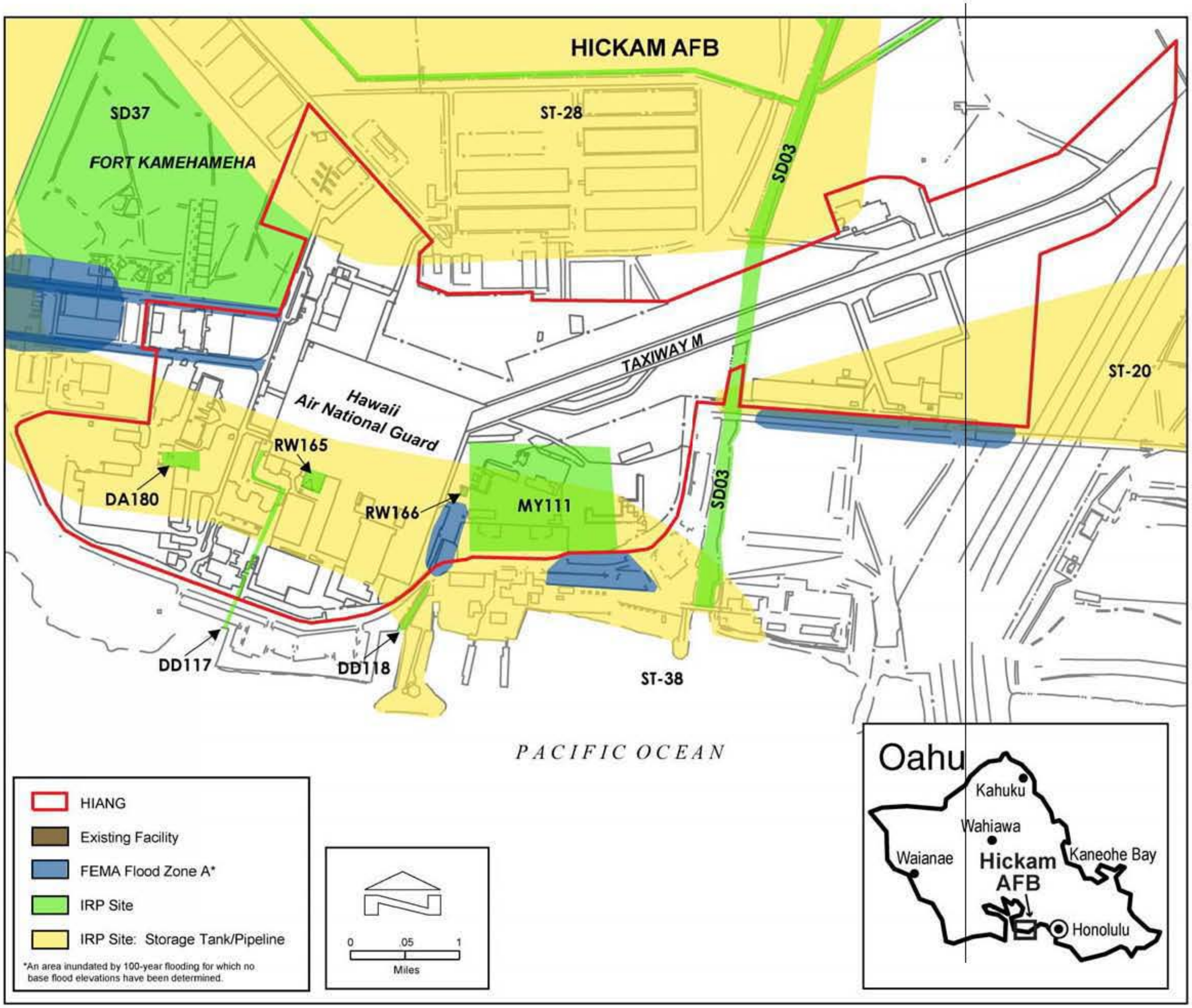


Figure 3.5-1. IRP Sites and Floodplains at Hickam AFB, Hawaii

3.5.2.3 Hazardous Materials and Waste Management

Hazardous Materials. The majority of hazardous materials used by Air Force and contractor personnel at Hickam AFB are controlled through an Air Force pollution prevention process called HAZMART-Hazardous Materials Pharmacy operated by the 15 AW. This process provides centralized management of the procurement, handling, storage, and issuing of hazardous materials and turn-in, recovery, reuse, or recycling of hazardous materials. The HAZMART process includes review and approval by Air Force personnel to ensure users are aware of exposure and safety risks. Pollution prevention measures are likely to minimize chemical exposure to employees, reduce potential environmental impacts, and reduce costs for material purchasing and waste disposal.

Aircraft flight operations and maintenance, as well as installation maintenance, require the storage and use of many types of hazardous materials, such as flammable and combustible liquids. These materials may include acids, corrosives, caustics, glycols, compressed gases, aerosols, batteries, hydraulic fluids, solvents, paints, pesticides, herbicides, lubricants, fire retardants, photographic chemicals, alcohols, and sealants.

Hazardous Waste. Hickam AFB is a large-quantity hazardous waste generator. Hazardous wastes generated during operations and maintenance activities may include combustible solvents from parts washers, inorganic paint chips from lead abatement projects, fuel filters, metal-contaminated spent acids from aircraft corrosion control, painting wastes, battery acid, spent x-ray fixer, corrosive liquids from boiler operations, sludge from washracks, aviation fuel from tank cleanouts, and pesticides. Hazardous wastes are managed in accordance with the Hickam AFB Hazardous Waste Management Plan developed by the 15 AW and by policies and procedures followed by the HIANG.

Hazardous wastes are initially stored by the HIANG at approximately 14 satellite accumulation points. Satellite accumulation points allow for the accumulation of up to 55 gallons of hazardous waste (or one quart of an acute hazardous waste) to be stored at or near the point of waste generation. There are two 90-day waste accumulation sites on Hickam AFB. One is operated by the 15th Logistics Readiness Division in Building 1070 and the second is operated by the 15th Civil Engineering Squadron in Building 4030. The base is identified by USEPA identification number HI8570028722. In 2005, over 45,000 pounds of hazardous waste were removed from Hickam AFB and disposed of in off-base permitted disposal facilities (Booz Allen Hamilton 2006).

The Hickam AFB Integrated Hazardous Materials Contingency Plan addresses on-base storage locations and proper handling procedures of all hazardous materials to minimize potential spills and releases. The plan includes Spill Prevention Control and Countermeasures Plan and further outlines activities to be undertaken to minimize the adverse effects of a spill, including notification, containment, decontamination, and cleanup of spilled materials.

Asbestos. Asbestos-Containing Materials (ACMs) are those materials that contain greater than 1 percent asbestos. Friable, finely divided, and powdered wastes containing greater than 1 percent asbestos are subject to regulation. A friable waste is one that can be reduced to a powder or dust under hand pressure when dry. Nonfriable ACMs, such as floor tiles, are considered to be nonhazardous, except during removal and/or renovation, and are not subject to regulation. The Hickam AFB Asbestos Management and Operating Plan provides guidance on the management of asbestos. An asbestos facility register is maintained by Civil

Engineering. Persons inspecting, designing, or conducting asbestos response actions in public or commercial buildings must be properly trained and accredited through an applicable asbestos training program. The design of building alteration projects and requests for self-help projects are reviewed to determine if asbestos contaminated materials are present in the proposed work area and, if so, are disposed of in an off-base permitted landfill.

Lead-based Paint. Lead-based paint (LBP) is defined as surface paint that contains lead in excess of 1 milligram per square centimeter as measured by X-ray fluorescence spectrum analyzer, or 0.5 percent lead by weight. Several structures associated with the transition to the F-22A weapon system may have the potential to have LBP on building surfaces. Demolition and renovation of facilities with LBP require special procedures and disposal. In 1993, OSHA, under 29 CFR Part 1926, restricted the permissible exposure limit for general industrial workers to 50 micrograms per cubic centimeter of air, which would include workers in the construction field. Hickam AFB has also developed a Lead-Based Paint Management Plan that provides guidance and procedures when renovating or demolishing facilities that may have material with lead-based paint.

Installation Restoration Program (IRP) (also known as Environmental Restoration Program [ERP]). The DoD developed the IRP to identify, investigate, and remediate potentially hazardous material disposal sites on DoD property prior to 1984. Figure 3.5-1 depicts IRP sites in the vicinity of the HIANG. The 15 CES/CEVR provides oversight and management for 60 IRP sites that are currently under long-term monitoring and/or further investigation (Air Force 2007). The 15 CES/CEVR coordinates IRP activities with the USEPA and the State of Hawaii Department of Environmental Health (HDOH).

The IRP sites described below are located either immediately adjacent to or within the area potentially affected by the F-22A beddown.

- **SD03 – Kumumauu Canal & Washracks** – The Kumumauu Canal & Washracks site has been active since 1941. The wastes that have been detected at this IRP site, or are potential chemicals of concern, included POL, solvents, heavy metals, pesticides, and herbicides (Air Force 2007). Approximately 600 linear feet of the Kumumauu Canal transect the eastern portion of the existing 154 WG property.

- **ST-20 – EOD Area USTs** – Fuel oil formally stored in USTs is the material of concern for this area of the 154 WG current property. The fuel oil USTs in this area were in use from 1942 through 1966. The 15 CES/CEVR is currently conducting a multiphase removal activity for these fuel USTs.

- **ST-28 – Hickam Runway USTs (minus ST28F)** – Heating oil, diesel, and POL formally stored in USTs are the materials of concern for this area. The USTs in this area were in operation from 1950 through 1973. One concrete waste oil tank was closed in place east of Mike Pad, near the proposed F-22A construction area. The 15 CES/CEVR is currently conducting a multiphase removal activity for these fuel USTs.

- **ST-38 – Fort Kamehameha Eastern Coast USTs** – These USTs containing diesel and gasoline were operated from 1915 through 1973. The 15 CES/CEVR is currently conducting a multiphase removal activity for these fuel USTs.

- **DO117/118 – Hawaii Air National Guard (HIANG) Drainage Canals** – This AOC addresses drainage canals where chemicals of concern are Polycyclic or Polynuclear

Aromatic Hydrocarbons, Polychlorinated Biphenyl, and metals. This AOC was identified under a PA, sampled under an SI, and No Further Response Action Planned (NFRAP) closure is underway (Air Force 2007). DO117/118 are located in the southwestern portion of the existing 154 WG property.

- **RW/65 – Wash Rack, HIANG –** This wash rack is located on the 154 WG property to the north of Building 11630 and has been in operation from 1963 to the present. The suspected contaminants are semi-volatile organic compounds (SVOCs), metals, and herbicides. The site was identified during the 1996 PA. An SI was completed and a NFRAP closure is underway (Air Force 2007).
- **RW66 – Wash Rack, HIANG, Building 3427 –** This site is for the wash rack that is adjacent to Building 3427, which is located in the southwestern portion of the 154 WG property. This wash rack has been in operation since 1963. The suspected contaminants identified for EA66 during the 1996 PA and the 1998 SI were VOCs, pesticides, herbicides, and metals (Air Force 2005a). A NFRAP closure is underway (Air Force 2007).
- **DA80 – Former Navy Tower** – This site is for the Former Navy Tower (Building 3387), which is located in the southwestern portion of the 154 WG property. The suspected contaminants identified during the 1996 PA, and the subsequent 1998 SI, were VOCs and pesticides (Air Force 2005a). A NFRAP closure is underway (Air Force 2007).
- **MY111 – Former HIANG Motor Pool** – The site encompasses Buildings 3426, 3428, 3427, 3431, 3427, 3440, including a portion of 3424. This site has just recently completed Phase I of a Remedial Investigation, which included soil and groundwater sampling. It should be noted that concentrations of lead and polychlorinated biphenyls exceeded HDOH action levels in soil and that arsenic was found in the groundwater at the site. The Remedial Investigation is not complete and will require Phase II sampling in order to delineate the extent of contamination.

Solid Waste Management. Solid waste generated at Hickam AFB in FY 2005 was about 15,000 tons and included two primary waste streams: municipal solid waste and construction and debris (C&D) wastes. These solid wastes were sent to either to the HPOWER Waste-to-Energy facility (6,000 tons) and those materials that cannot be processed there went to the Waimanalo Gulch Sanitary Landfill (9,100 tons) located outside of Honolulu. Wastes from Hickam AFB disposed of at the landfill accounted for 0.5 percent of the total disposal rate at the Waimanalo Gulch Sanitary Landfill. The landfill receives an estimated 2,000 tons per day of municipal solid waste from all of Oahu. The current closure date for the landfill is 2008 based on the original design capacity. Landfill management is currently working with USEPA Region 9, local community leaders, and other stakeholders on plans to extend the life of the landfill (Booz Allen Hamilton 2006).

Hickam AFB has initiated numerous successful pollution prevention programs which have resulted in a decrease in the municipal solid waste and C&D debris being sent to local landfills. One program that has significantly reduced the amount of solid waste is the installation recycling program. The installation recycling program is run as an in-house effort using a combination of civilian over-hires and prison labor. All recyclables, including housing generated, are collected and sorted at the installation recycling center. In calendar year 2005, Hickam AFB recycled almost 1,400 tons of materials and had an averaged diversion rate of 35.9 percent (Booz Allen Hamilton 2006).

3.5.3 Military Training Airspace

3.5.3.1 Marine Resources Under Airspace

Warning Areas associated with the Proposed Action occur over the deep waters of the North Pacific Ocean. These waters overly a vast abyssal plain, an area of seafloor that may be interrupted by undersea mountains but generally pan flat. The abyssal plain of the North Pacific is on average 2.5 miles below MSL and is a portion of a vast network of similar features that span the globe. In terms of area, abyssal plains area the most significant geologic features on the planet. They are little known because they are found entirely out of view in the deep sea.

Waters of the Pacific Ocean north of the Equator generally swirl in a clockwise direction. The California Current moves down the western coast of North America and turns to the west to cross the entire Pacific Ocean as the North Pacific Equatorial Current. When this current reaches Japan, it turns to the North and follows the coast of Asia on its way toward Alaska. Thus waters of the North Pacific generally move in a clockwise fashion.

In the middle of this giant swirl (at about 30° N Lat) is an area of still water called the North Pacific Gyre. Floating material (both natural planktonic materials and human) in the Pacific Ocean eventually gathers in the gyre. Non-degrading materials, like plastics, will persist on the surface in the gyre indefinitely. Periodically, stochastic processes cause masses of floating debris to escape the gyre and re-enter circulating currents. Sometimes mobilized debris is then deposited along the mainland coasts or the north shores of the Hawaiian Islands. The North Pacific Gyre lies to the north of Hawaii.

Hawaii and the Warning Areas under the Proposed Action reside in the midst of the North Pacific Equatorial Current. Ocean water here tends to move from East to West. Within this current, the Hawaiian Islands act much like "a rock in the stream." A vast oceanic eddy is created and water masses move in behind them from the West. This creates a Hawaiian Lee Counter Current that actually has been shown to draw water from Asia back toward the leeward side of the Hawaiian Islands.

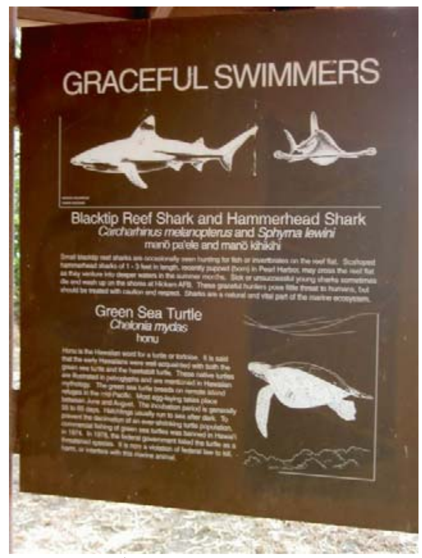
3.6 Natural Resources - Biological Resources

3.6.1 Definition of Resource

The term "biological resources" refers to plant and animal species existing in an uncultivated or wild state in environs affected by the Proposed Action. It includes both native and introduced species and the habitats within which they occur. Groups of species that are linked by ecological processes within a defined area are referred to as ecological communities. Ecological communities may be terrestrial, freshwater, or marine. Wetlands are special communities that occur at the interface between upland communities and either freshwater or marine communities. Most ecological communities (terrestrial and near-shore communities) are identified by a characteristic assemblage of dominant plant species or other sessile biotic elements (e.g., corals or macroalgae.) Open water marine communities, in contrast, are often defined by phytoplanktonic, animal, or physical oceanographic elements. For discussion of the physical aspects of aquatic ecosystems, see Section 3.5, Natural Resources-Physical Resources.

The spatial and functional portion of a community within which a species obtains its required resources (energy, nutrients, water, shelter, space, temperature, etc.) is defined as its habitat. For many animal species, habitat use varies with season and life history stage. Within a particular ecological setting, the quality and attributes of available habitat determine wildlife composition, diversity, and abundance. Habitat requirements, species interactions, and tolerance establish observed distribution and abundance patterns of individual species. For this reason, habitat type, quality, and area affected will provide the dominant perspective in establishing baseline conditions and assessing potential impacts.

Ecological communities and the species they support are presumed to have intrinsic value. They are sources of biological diversity, important for nutrient, water, and atmospheric gas cycling, and are linked to regional and global ecosystem functions; they also provide aesthetic, recreational, and socioeconomic values to society. This biological resources section focuses on animal species and vegetation types or habitats that typify or are important to the function of the ecosystem, are of special societal importance, or are listed as endangered or threatened under federal or state law or statute.



Hickam AFB includes natural areas west of the HIANG facilities that contain visitor interpretive signs.

Federal laws and regulations that apply to biological resources include Fish and Wildlife Coordination Act, Migratory Bird Treaty Act, Clean Water Act, NEPA, ESA, Sikes Act, Marine Mammal Protection Act, and Magnuson-Stevens Fishery Conservation and Management Act. A variety of Hawaii State laws (e.g., HRS 195D-4) confer protection to all species listed under ESA and provide provisions for management, conservation, and implementing habitat conservation plans.

Biological resources are organized into three major categories, as appropriate: (1) habitat and ecological communities, including plants and animals, (2) wetlands, and (3) special-status species. As stated above, a habitat-level perspective governs both descriptions of existing conditions and analyses. The following defines the wetland and special status species categories.

Wetlands are a special category of Waters of the U.S. and are subject to regulatory authority under Section 404 of the Clean Water Act and EO 11990, *Protection of Wetlands*. Jurisdictional wetlands are those defined by the U.S. Army Corps of Engineers (USACE) and USEPA as meeting all the criteria defined in the USACE's *Wetlands Delineation Manual* (Environmental Laboratory 1987) and fall under the jurisdiction of the USACE. Recent Supreme Court decisions and subsequent guidance have determined that isolated wetlands do not have jurisdictional status and are not subject to regulation under Section 404 of the Clean Water Act. It is highly unlikely this guidance would be applicable in most coastal settings. Certain activities in jurisdictional wetlands, including dredging or placement of fill, are regulated and require a permit under Section 404 of the Clean Water Act.

Special-status species are defined as those plant and animal species listed as threatened, endangered, candidate, or species of concern by the USFWS or the NOAA NMFS. The ESA protects federally listed threatened and endangered plant and animal species. Candidate species are species that USFWS is considering for listing as threatened or endangered but for which a proposed rule has not yet been developed. Candidates do not benefit from legal protection under the ESA. In some instances, candidate species may be emergency-listed if USFWS determines that the species population is at risk due to a potential or imminent impact. The USFWS encourages federal agencies to consider candidate species in their planning process because they may be listed in the future and, more importantly, because current actions may prevent future listing. Species of concern are species for which data were inconclusive to support ESA protection at the time of the proposed listing. It is an informal designation, although USFWS recommends tracking of population trends and threats. More federally listed animal and plant species occur in the State of Hawaii than any other state in the U.S. Hawaii's ESA (HRS, Sect. 195D-4(a)) requires that federal listing automatically invokes listing under Hawaii State law, which prohibits taking and encourages conservation by state government agencies. Therefore, for Hawaii, state and federal lists of special status species are identical. The Hawaii Natural Heritage Program maintains a database of listed species, species of special concern, and endangered natural communities.

3.6.2 Hickam AFB

Hickam AFB is located in a coastal urban area immediately west of the City of Honolulu but within the Great Honolulu Metropolitan Area on the island of Oahu. The base is bordered by Honolulu International Airport, with which it shares some airfield elements, the Interstate H1 transportation corridor, urban development, Pearl Harbor Naval Station, and Mamala Bay, part of the North Pacific Ocean.

Most of the base area is developed atop fill material dredged during harbor channel creation and deposited over emergent reef and alluvium associated with the Pearl Harbor Coastal Plain. Portions of the base near its shoreline margin were developed above active coral reefs and coastal wetlands "reclaimed" through this process. The result is a nearly level platform for base development that rests just above mean sea level. Unamended fill soils are predictably alkaline and haline, providing little value to most vegetation.

No natural vegetation habitat is present at Hickam AFB. Members of Hawaii's unique native flora are often used in base landscaping; however, no native plant communities have been established. Because large areas of the base are developed upon fill material deposited on shallow coral reefs, much of the base had no historic vegetation prior to base construction. The base setting is a mosaic of mission facilities, residences, roadways, tarmac, lawns, world-class landscaping features, and patches of unmanaged vegetation. General vegetation types found at Hickam AFB are summarized in Table 3.6-1. Currently, 62.2 percent (1,567.3 acres) of the base is vegetated, the rest being under complete development such as buildings, roads, and airfield.

Table 3.6-1. General Vegetation Types Present at Hickam AFB

Type	*Acres*	*Percent of Total Base Area*
Buffelgrass-kiame woodland	27.8	1.1
Kiawe forest	123.2	4.9
Pickleweed flats	18.2	0.7
Mangrove	14.1	0.6
Mixed herbaceous disturbance communities (managed)	344.4	13.7
Landscaped area	1,039.6	41.2
Total vegetated area	1,567.3	62.2

In many areas of unmanaged vegetation, kiawe, an introduced invasive mesquite native to xeric coastal areas of western South America, has established itself as the dominant shrub or tree species. Where left completely unchecked, mature kiawe can reach heights of 20 to 30 feet and form dense forests. Small kiawe forests may be observed in association with herbaceous ground cover near Hickam AFB Golf Course and Fort Kamehameha. Upland areas near recreational fields support open woodlands of buffelgrass and scattered kiawe.

Introduced invasive species are established in the areas of Fort Kamehameha.

Along the southern periphery of the base and extending inland approximately 1,500 feet, seawater penetration into shallow groundwater produces saline conditions conducive to the growth of halophytes. Here monocultures of pickleweed thrive. Beyond this and lining base canals and ditches, scattered thickets of mangrove may be found.

Un-landscaped areas that are mowed and otherwise managed for low vegetation growth support an herbaceous groundcover of disturbance tolerant, weedy species. These so-called "ruderal vegetation" areas fill in between other areas throughout the base. Buffelgrass is the most common species. In some places this vegetation takes on a turf-like appearance; in other areas it is more shrubby.

Vegetation at Hickam AFB does not provide quality habitat for native wildlife species. Typical species encountered in terrestrial habitats include a collection of species typical of urban developed sites on Oahu. A vast majority are introduced. Species surveys have revealed the presence of feral cats and dogs, mongoose, rats, mice, mynas, sparrows, doves and the like. Turf areas support ground-feeding exotic birds as well as migratory species such as Pacific plovers and ruddy turnstones. Kiawe forest areas support black-crowned night herons and barn owls. The shells of introduced snails are common on the ground in many unmanaged areas.

Both freshwater and marine wetlands exist on Hickam AFB to a limited extent. Most are found in flat or depressional areas, along the coastline, and along canals and ditches. Base resource managers have divided base wetlands into three categories: 1) shoreline, 2) ephemeral emergent, and 3) canal.

Shoreline wetlands at Hickam AFB include mangrove-dominated wetlands and sandy beaches. Mangrove stands provide cover, nesting, and feeding habitat for songbirds. The mangrove prop roots stabilize the shoreline and provide cover for many juvenile fishes. Sandy beaches are not considered jurisdictional wetlands, but provide foraging habitat for sandpipers and other shorebirds such as Pacific golden plovers, wandering tattlers, and sanderlings.

Ephemeral emergent wetlands are seasonally or temporarily inundated. Following heavy rains or excessive irrigation, these areas provide habitat for shorebirds and waders.

No natural drainages cross Hickam AFB property. Canal wetlands are considered excavated and have distinct banks and margins. Seaward they receive a strong marine influence; inland, they take on more freshwater character. Typical bird species occurring in these areas include plovers and other shorebirds, cattle egrets, and black-crowned night herons. Hawaiian coots and common moorhens have also been noted. In many areas, steep banks and deep water provided limited habitat for shorebirds and waders. Canal wetlands also provide habitat for are variety of fish species and invertebrates.

Nine special status species have been identified as occurring or having the potential to occur at Hickam AFB. These species are summarized in Table 3.6-2.

3.6.3 Military Training Airspace

Airspace elements affected by the Proposed Action include offshore Warning Areas and ATCAAs described in Chapter 2.0. This region of the North Pacific Ocean is dominated by the westward-flowing North Equatorial Current and the Hawaiian Lee Countercurrent. These features influence water temperatures, nutrient transport, debris movement, and migratory patterns affecting large pelagic marine species.

The existing environment under the airspace currently experiences sonic booms from F-15 training and plastic, nylon, and aluminum-coated wrapping materials deposited whenever chaff or flares are deployed. Under the most heavily used airspace, W-189, an estimated 5 to 8 pieces of chaff or flare debris are deposited annually per square mile. The chaff and flare materials are further discussed in Appendices A and B. The F-15 training is currently estimated to result in six to seven sonic booms per month under W-189 and fewer booms per month in any other airspace. Appendix E describes aircraft subsonic and supersonic noise.

Five special status species potentially affected by the Proposed Action under airspace include those listed in Table 3.6-3. One is a mammal (humpback whale); the remainders are sea turtles. A fifth turtle, the green turtle, is common in Hawaiian waters but is likely limited to nearshore environments.

Table 3.6-2. Special Status Species Occurring or Potentially Occurring at Hickam AFB

Common Name	*Scientific Name*	*Federal Status*	*Occurrence at Hickam AFB*	*Notes*
Hawaiian hoary bat	*Lasiurus cinereus semotus*	Endangered	No records. Transient occurrence possible	Oahu records outside vicinity of Honolulu. Tree roosting species.
Humpback whale	*Megaptera novaeangliae*	Endangered	No records. Some incidental offshore occurrence possible	Wintering areas offshore.
Hawaiian monk seal	*Monachus schauinlandi*	Endangered	No records.	Observed hauling out across harbor from base.
Hawaiian duck	*Anas wyvilliana*	Endangered	No records on base.	Observed approximately 3 miles from base. May find some habitat on base.
Hawaiian short-eared owl	*Asio flammeus sandwicense*	Species of Concern	Injured owl found on base in 2003. Only record.	Ground nester. Unlikely to find nesting success in urban areas.
Hawaiian coot	*Fulica americanus alai*	Endangered	Not observed on base.	May find some habitat in Manuwai Canal.
Common moorhen	*Gallinula chloropus sandvicensis*	Endangered	Recorded at tidal flats on base.	May find some habitat in Manuwai Canal.
Black-necked stilt	*Himantopus mexicanus knudseni*	Endangered	Observed in wetland areas of base.	Finds foraging habitat with other shorebirds in appropriate areas of base.
Green turtle	*Chelonia mydas*	Threatened	Adults and juveniles observed in base vicinity.	Common around Oahu. May find forage in macroalgae patches near base shore.

Source: NOAA NMFS and USFWS 1998a, 1998b, 1998c, 1998d, 1998e; USFWS 1998, 2005

Table 3.6-3. Special Status Species Occurring in Offshore Marine Habitats beneath Training Airspace

Common name	*Scientific name*	*Federal Status*
Humpback whale	*Megaptera novaeangliae*	Endangered
Loggerhead turtle	*Caretta caretta*	Threatened
Leatherback turtle	*Dermochelys coriacea*	Endangered
Hawksbill turtle	*Eretmochelys imbricata*	Endangered
Olive ridley turtle	*Lepidochelys olivacea*	Threatened

3.7 Cultural Resources

3.7.1 Definition of Resource

Cultural resources are historic districts, sites, buildings, structures, or objects considered important to a culture, subculture, or community for scientific, traditional, religious or other purposes. They include archaeological resources, historic architectural/engineering resources, and traditional resources. Cultural resources that are eligible for listing in the National Register of Historic Places (NRHP) are called historic properties. Historic properties are evaluated for potential adverse impacts from an action. In addition, some cultural resources, such as Native Hawaiian traditional or sacred sites, may not be historic properties but are also evaluated under NEPA for potential adverse effects from an action. These resources are identified through consultation with appropriate Native Hawaiian groups.

3.7.2 Hickam AFB

The boundary between the Ewa District and the Kona District of the traditional Hawaiian land division system divides Hickam into two nearly equal parts. The eastern portion of the base is in the Moanalua *Ahupua'a* of the Kona District, and the western portion of the base is in the Halawa *Ahupua'a* of the Ewa District.

3.7.2.1 Historical Setting

Human occupation of the Hawaiian Islands began with the arrival of Polynesians, most likely from the Marquesas Islands, sometime before A.D. 600 (Hickam AFB n.d.). The Colonization Period (A.D. 300 to 600) marks the beginning of the Hawaiian cultural sequence. A variety of resources were exploited by the first settlers, including domesticated plant and animal resources they brought to Hawaii. During the Development Period (A.D. 600 to 1100) there is evidence of permanent, dispersed settlements throughout the fertile windward valleys. The Expansion Period (A.D. 1100 to 1650) was marked by a dramatic population increase, complex agricultural schemes, and elaborate religious structures with a highly stratified society in which religion was the central focus. Subsistence included taro cultivation, large irrigation networks, and aquaculture. There was also increased habitation of more arid regions of the leeward valleys and coasts. The Proto-Historic Period (A.D. 1650 to 1795) ended shortly after European contact. Subsistence activities still focused on agricultural and marine practices, but there was an increased emphasis on specialized crafts with an abundance of elite status goods, suggesting increased internal conflict and rivalry. Population growth generally slowed and some settlement areas were abandoned (Hickam AFB n.d.).

When Captain Cook arrived in 1778, the Hawaiian Islands were organized around hierarchical chieftainships. They were unified in 1795 after King Kamehameha's victory at the Battle of Nu`uanu. As the islands opened up to the sandalwood trade, the number of foreigners increased. In 1819, Kamehameha died and the religious *kapu* system was overthrown, allowing missionization of the islands. After the introduction of Christianity, transfer of land ownership (from the feudal system to a fee simple basis) under the Great *Mahele* in 1848 resulted in major changes, redirecting cultural development of the islands (Hickam AFB n.d.).

Military History

At the beginning of the 20th century, the U.S. entered into a new phase of military activity with the acquisition of territories in the Pacific Ocean. Defense of the Pacific territories was considered essential to national security and the advent of air power allowed control over a vast area of ocean and islands in the Pacific. The naval base at Pearl Harbor was designated as the major defense installation for Hawaii. It was to be defended by a series of coastal forts, one of which, Fort Kamehameha, was placed at the entrance to Pearl Harbor.

Land for the fort was acquired by condemnation of the estate of Queen Emma in 1907, allowing for construction of what became Fort Kamehameha (Hickam AFB n.d.). Since much of the land was submerged, the Navy conducted large-scale dredging in Pearl Harbor channel to obtain fill material to deposit in the marshes that adjoined the beach. The fort was originally named Fort Upton, but in 1911 was renamed Fort Kamehameha after a petition to create a memorial to King Kamehameha I, who united the Hawaiian Islands under his rule. Four batteries were constructed: Battery Selfridge (1913); Battery Jackson (1914); Battery Hawkins (1914); and Battery Hasbrouck (1914). The Battery Hawkins Annex was used to store mines. In 1920, Battery Closson was added (ANG 2005).

U.S. Army air activity in the Hawaiian Islands began in 1913 when a Signal Corps Aviation Station was assigned to Fort Kamehameha. The first of several key air bases were established in the general area of Pearl Harbor on Oahu while World War I was underway in Europe. In 1934, a modern airdrome was constructed by the Quartermaster Corps on land bounded by Pearl Harbor channel on the west, Pearl Harbor Naval Reservation on the north, John Rodgers airport on the east, and Fort Kamehameha on the south. This project was named Hickam Field, after Lieutenant Colonel Horace Meek Hickam. Hickam became the principal army airfield in Hawaii and the only one large enough to accommodate the B-17 bomber.

Hickam Field suffered extensive damage in the Japanese attack on Oahu military installations in 1941. Following the outbreak of World War II, it was expanded to support the Seventh Air Force and the Hawaiian Air Depot. During the war, Hickam served as a supply center and supported aircraft ferrying troops and supplies to Asia in World War II, during the Korean conflict, and during the Vietnam War (Hickam AFB 2003). In the 1960s and 1970s, the 15 AW at Hickam supported the Apollo astronauts; Operation Homecoming, the return of prisoners of war from Vietnam; and Operation Babylift (Hickam AFB 2003).

The HIANG consists of HIANG Headquarters, the 154 WG, the 201 CCG, and the 199th Weather Flight. The 154 WG evolved from a single unit mission initially organized on December 1, 1960 (HIANG 2003). The 154 WG, headquartered at Hickam, currently flies the C-130 Hercules, the F-15 Eagle, C-17 transports, and the KC-135 Stratotanker. It is the only National Guard unit with responsibility for air defense of a state (Hickam AFB 2003).

3.7.2.2 Identified Cultural Resources

Archaeological Resources

Archaeological resources in the Hickam AFB area include fishpond complexes, mortuary activity areas, seasonal occupation areas, historic 1800s settlements, early 1900s settlements, and early military sites. Historic maps indicate that several Hawaiian fishponds once existed in the vicinity: Loko Keoki, Loko Waiaho, Loko Papiolua, Lelepaua, Ka`ihikapu Fishpond, and some unnamed ponds. These ponds were filled in during construction activities at Hickam Field and Fort Kamehameha Military Reservation in the early 1900s. The exact subsurface location of some of the ponds is still in question, although the location of Loko Waioho is thought to be just north of, and partially within the northeast portion of the HIANG area (Figure 3.7-1) (Hickam AFB n.d.). The coastline of Fort Kamehameha contained Pre-Contact and Post-Contact burials of Native Hawaiians. Between 1975 and 1993, more than 30 human burials were found at Fort Kamehameha (Hickam AFB n.d.).

Historic maps show few settlements in the area of Hickam AFB in the 1800s. One notable exception was the home of Queen Emma. The exact location of her house has yet to be determined, but research suggests that the structure was probably in the southwest corner of Fort Kamehameha at the western edge of the HIANG facility. Although the Queen died in 1885, there is some evidence to suggest that her residence remained in place as late as 1913 when it was said to be near the old dispensary (Hickam AFB n.d.). Other scattered settlements during this time period include Halekahi, Holokahiki, and Poi Village. In 1908, Holokahiki Village was renamed Watertown for the piped fresh water system built for dredging Pearl Harbor. The new residents of Watertown consisted of Russians, Hawaiians, and Japanese. In 1935, the housing area at Watertown was condemned for the construction of an airfield for Hickam AFB. Until the lands were condemned, sugarcane cultivation continued in the northern portions of Hickam AFB. Workers for the Honolulu Plantation Company were housed in an area known as Pu`uloa Camp.

The earliest military remains at the Hickam AFB area come from Fort Kamehameha, first occupied in 1913. These include concrete foundations, walkways, a roadway, ammunition storage bunkers, and an air raid shelter. More than 4,800 artifacts have been recovered from the site.

The Base Historic Preservation Office (BHPO) has identified three levels of sensitivity for the presence of archaeological resources (Hickam AFB n.d.). High probability areas include locations highly sensitive for the presence of NRHP-eligible archaeological sites, such as portions of Fort Kamehameha west of HIANG. Medium probability areas have a moderate sensitivity for the presence of archaeological resources and make up a small portion of HIANG. Low probability areas with a correspondingly low sensitivity for the presence of archaeological resources comprise the majority of the HIANG area.

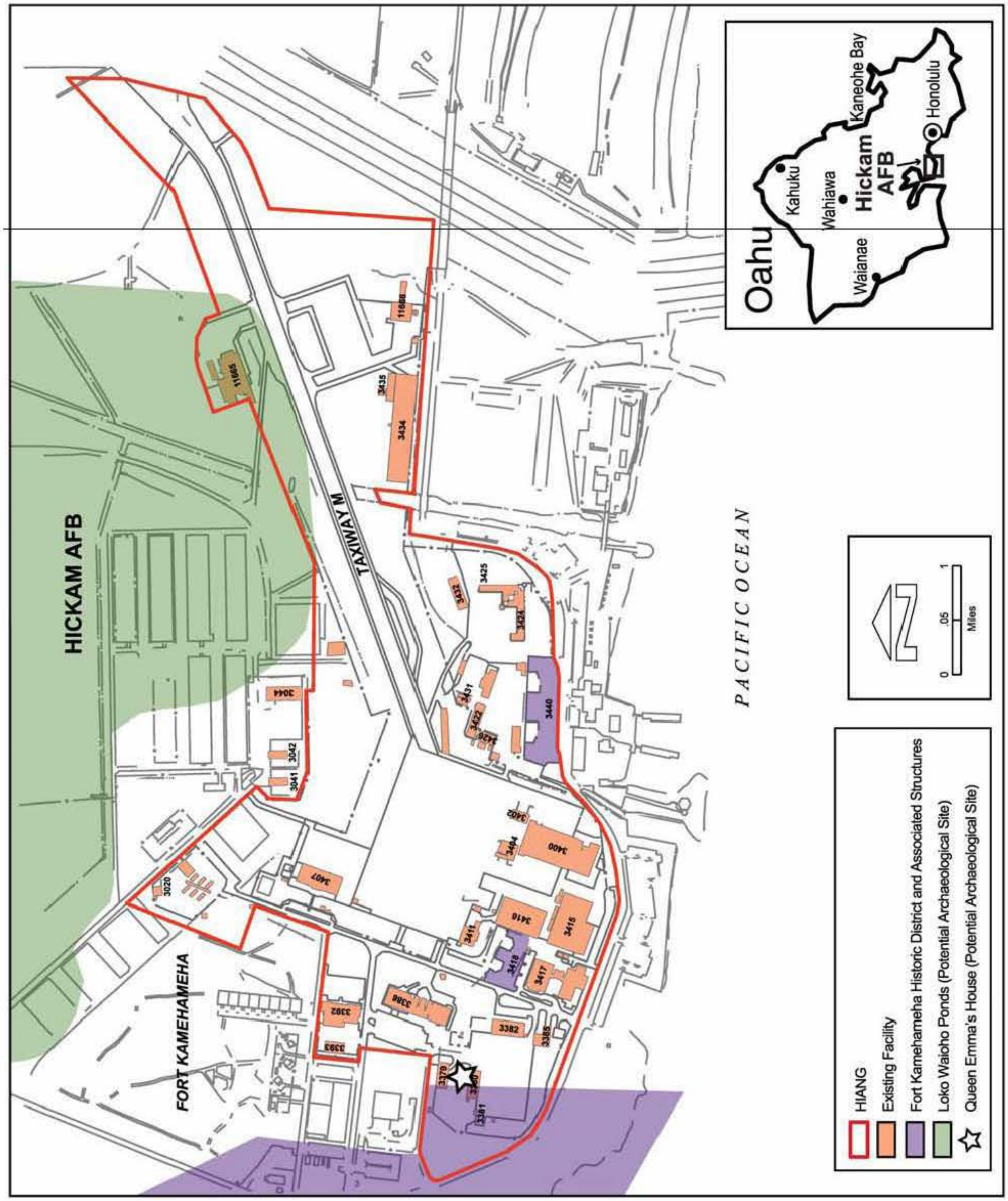


Figure 3.7-1. Known or Potential Cultural Resources on Hickam AFB

Architectural Resources

A part of Hickam AFB was designated a National Historic Landmark in 1980 as one of the most significant historic resources associated with World War II in the Pacific (Hickam AFB 2003). The base has two historic districts: Hickam Historic District (including Hickam Field National Historic Landmark), and Fort Kamehameha Historic District (Figure 3.7-1 and Table 3.7-1). The HIANG facility lies adjacent to Fort Kamehameha, along its eastern border. The southern portion of the HIANG facility occupies the area where the military facilities of Fort Kamehameha once stood.

The historic Fort Kamehameha housing district borders the western edge of the HIANG facility.

Table 3.7-1. National Register Listed Resources, Hickam AFB

Facility	*Location*	*Period*
Battery Hasebrouck	Fort Kamehameha Historic District	1900-1924
Battery Hawkins Annex	Fort Kamehameha Historic District	1900-1924
Battery Jackson	Fort Kamehameha (HIANG area)	1900-1924
Battery Selfridge	Fort Kamehameha (HIANG area)	1900-1924
Hickam Field National Historic Landmark	Hickam AFB	1925-1949

Source: National Register Information Service 2006

The housing and military facilities of Fort Kamehameha define a historic district that exemplifies military life in Hawaii prior to the age of air power (Hickam AFB n.d.). Built in the early 1900s, the buildings at Fort Kamehameha represent a unique architectural style not seen elsewhere on Hickam AFB. Other historic buildings at Fort Kamehameha are the Observation Tower, storage buildings, gazebo, pump house and water storage tank, the Fort Kamehameha Pier, the Signal Corps building, and the chapel. Many temporary structures were constructed there during World War II, but most were demolished after the war.

There are two NRHP listed buildings or structures within the HIANG facility at Hickam AFB (Table 3.7-1). Battery Jackson and Battery Selfridge are two of Fort Kamehameha's batteries that are situated outside of the Fort Kamehameha Historic District and are inside the HIANG facility (Figure 3.7-1). Cold War-era HIANG buildings and structures have been evaluated and determined by Hickam AFB to be ineligible for listing on the NRHP (see Appendix C).

Traditional Cultural Properties and Native Hawaiian Concerns

Although no traditional cultural properties have yet been identified on Hickam AFB, Native Hawaiian groups have concerns regarding the burials located on Hickam AFB property. Ongoing consultation between the Air Force and Native Hawaiian groups on this and other issues is conducted on a government-to-government basis (personal communication, Nāmu`o 2006).

3.8 Land Use and Transportation

3.8.1 Definition of Resource

Two types of land use are considered in this section: human-created and natural. Human-created land uses can include the "built" environment such as residential, industrial, and commercial, as well as less developed uses such as agricultural or recreational. Recreation resources are those adjacent to the HIANG facilities and those which could occur under the airspace. Natural land uses include categories such as forested, open space, and wildlife areas. Other considerations when analyzing land use involve land ownership, land management plans, and applicable plans and ordinances. Land ownership is a categorization of land according to type of owner. Land use plans and ordinances, policies, and guidelines determine the types of land use that are allowable and establish appropriate goals for future land use.

Transportation resources include the infrastructure required for the movement of people, materials, and goods. For this analysis, the discussion of transportation focuses on the road system on Hickam AFB.

3.8.2 Hickam AFB

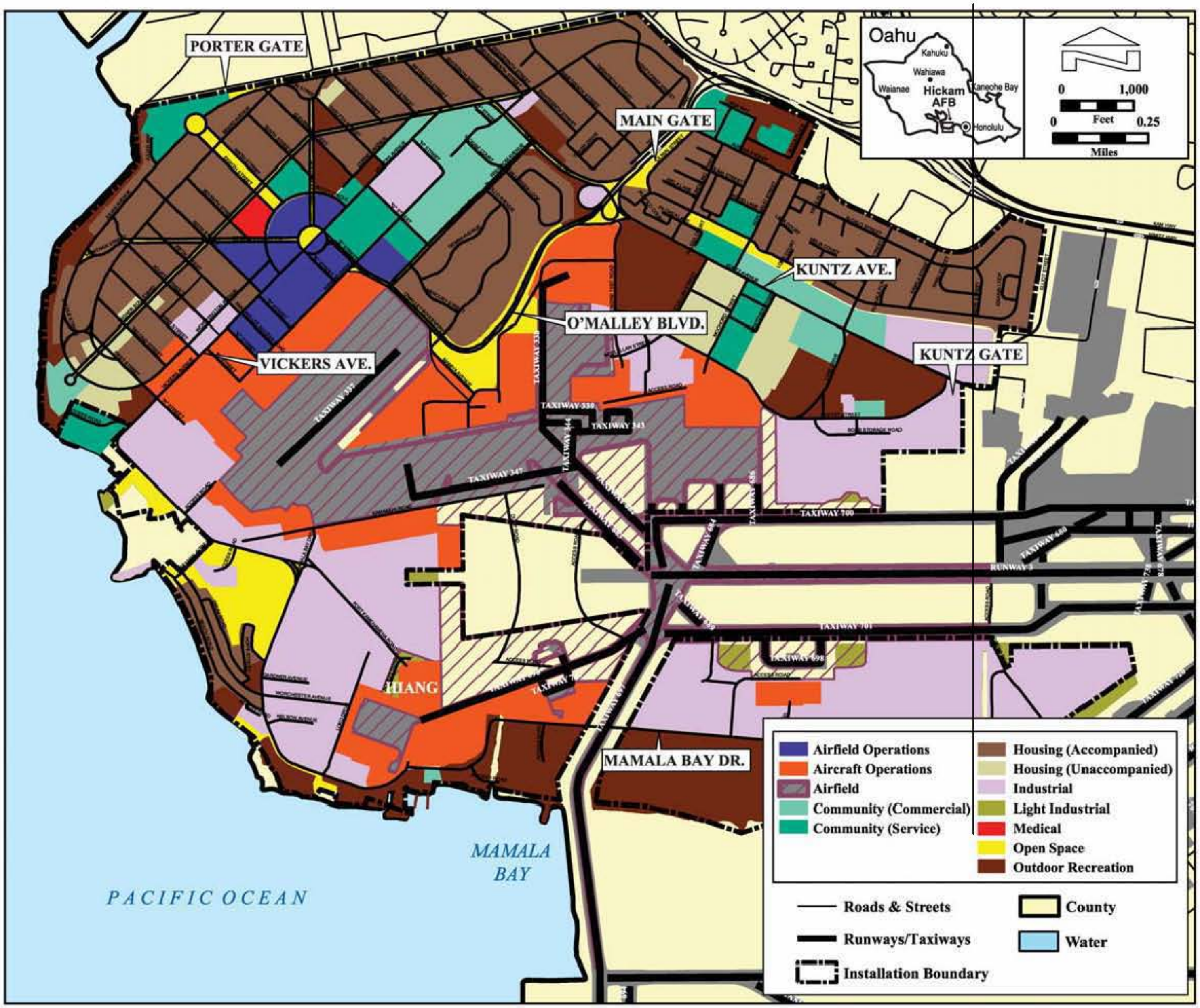
3.8.2.1 Land Use

Hickam AFB is located approximately 9 miles east of downtown Honolulu and is bordered by Honolulu International Airport to the east, U.S. Naval Base (USNB) Pearl Harbor to the north and west, and the Mamala Bay to the south. The approximately 2,520 acre base is located within the Honolulu Primary Urban Center as identified by the Oahu General Plan (City and County of Honolulu 2006). The major land ownership categories associated with Hickam AFB include federal and state. Hickam AFB does not share a boundary with any land in private ownership. The dominant land use feature of the installation is the airfield, which consists of 9,000 to 12,300 foot runways, associated taxiways, aprons, refueling, and aircraft support facilities. The runways are operated under a joint use agreement with the Honolulu International Airport, which is owned by the State of Hawaii.

Existing land use on Hickam AFB is divided into 11 categories (Figure 3.8-1). The categories pertaining to housing, community services, and administration are clustered in the northern half of the installation. These land uses include accompanied and unaccompanied housing, community-related services, and commercial services such as the post office, Base Exchange, and commissary. The land use categories that directly support the military mission are located in the southern half of the installation. These include the airfield, light industrial, and aircraft operations (Air Force 2006b).

Open space and outdoor recreational land uses are scattered throughout the installation, but are generally toward the outer edges of base away from the airfield, which dominates the center of base. Along the southern border of the installation, coinciding with the oceanfront, are high quality recreational resources, including white sand beaches and an 18-hole golf course (Air Force 2006b).

Figure 3.8-1. Existing Land Use on Hickam AFB



The proposed site for the F-22A is the HIANG facility located in the southwestern corner of Hickam AFB. The HIANG occupies two parcels totaling approximately 228 acres. The primary facilities supporting the 154 WG are located on a 128-acre parcel on the south end of Hickam AFB, at the southwest end of Runway 8L/26R. This area has existing land use designations for aircraft operations, airfield, and light industrial uses. Located along the coastline and nearby Foster Point and Hickam Beach, this area is within the Coastal Zone Management Area. The second parcel, used by other units of the ANG, is about 100 acres in size and is located north of the 128-acre parcel.

The proposed future land use on Hickam AFB is generally the same as existing land use with a few changes. The amount of area designated as airfield and aircraft operations is expanded by reducing the amount of light industrial and open space land uses. Additional open space is designated elsewhere, however, thereby not reducing the total amount. The designation on a small parcel of commercial community services is changed to an open space designation. Within the HIANG facility, the amount of land designated as airfield increases and aircraft operations decrease (Air Force 2006c).

Two special interest areas in the vicinity of Hickam AFB are underneath the take-off and approach path of the existing F-15 aircraft and proposed F-22A aircraft are Keehi Lagoon Beach Park and Sand Island State Recreation Area. Both of these areas are designated general preservation district. The Keehi Lagoon Beach Park is located at the northeastern point of the airport complex along the Keehi Lagoon. Sand Island State Recreation Area is located on the oceanfront portion of Sand Island. These areas were established by the city and state governments to provide an outdoor recreational opportunity for city dwellers.

The installation's General Plan presents a planning strategy to guide future facility development and preserve "the unique history, culture and environment associated with Hickam AFB" (Air Force 2006b). The beddown of the C-17 aircraft at Hickam AFB in 2006 influenced the focus of the General Plan and will continue to influence future development on base. Three additional issues on base were of special interest in the General Plan –– beach area redevelopment, Kuntz Road overpass realignment, and security forces consolidation. Future land use on base, as specified in the General Plan, will be strongly directed by these four focus areas (Air Force 2006b).

Airfield operations dominate the current and future land use at Hickam AFB. Unique considerations for land use occur in areas around airfields. These considerations are related to the potential for aircraft mishaps and the noise created by aircraft operations. The Air Force utilizes a program called Air Installation Compatible Use Zone (AICUZ) to identify areas of potential accidents and promote compatible land use in areas around airfields. An installation's AICUZ program identifies Accident Potential Zones (APZs) and Clear Zones (CZs) at the end of runways in which aircraft mishaps are more likely to occur. Figure 3.8-2 shows CZs, APZs, and Landing Clear Zones (LCZs). To minimize the results of potential accidents involving aircraft operating from Hickam AFB, Air Force CZs and APZs have been identified where base development is either prohibited or limited, although waivers are often granted.

The Air Force CZ is an area 3,000 feet wide by 3,000 feet long for both Class A and Class B runways, and is located at the immediate end of the runway. The accident potential in this area is at a level that no building is allowed. For safety reasons, the military is authorized to purchase the land for these areas if not already part of the installation.

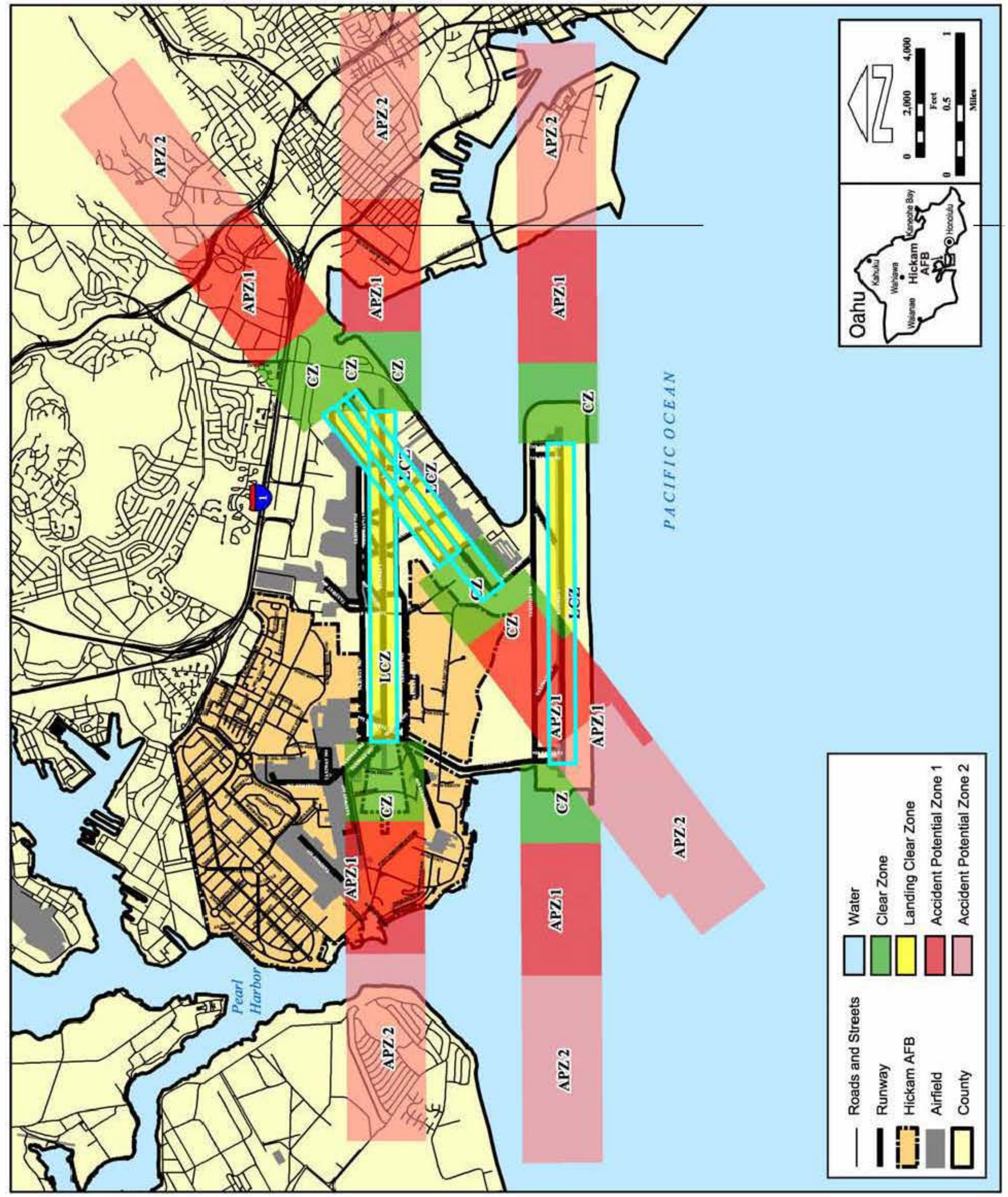


Figure 3.8-2. Hickam AFB Clear Zones and Accident Potential Zones

The Air Force APZ I is less critical than the CZ, but still poses potential for accidents. This 3,000-foot wide by 5,000 foot-long area located just beyond the CZ, has land use compatibility guidelines that allow a variety of industrial, manufacturing, transportation, communication, utilities, and open space. Uses that concentrate people in small areas are not compatible.

The Air Force APZ II is less critical than APZ I, but still poses potential for accidents. APZ II is 3,000 feet wide and extends 7,000 feet beyond APZ I. Compatible land uses include those of APZ I, as well as low density single family residential, and commercial retail trade uses with low intensity or scale of operation. High density functions such as multi-story buildings and places of assembly (e.g., theaters, schools, churches, and restaurants) are not considered compatible.

Honolulu International Airport is a joint use facility and as such the airport is an FAA Part 139 Certified Airport and has 1,000 foot long runway safety areas plus 1,700 foot long runway protection zones at the end of its runway in an effort to limit development in those safety areas. These areas are depicted in the FAA's Airport Layout Plan.

The AICUZ also identifies noise contours associated with aircraft operations. The noise contours are generated by an Air Force approved modeling program known as NOISEMAP. Knowledge of noise exposure around the base aids in planning for compatible land uses since elevated noise levels are incompatible with certain types of land use. When noise levels exceed an L_{dn} of 65 dB, residential land uses are normally considered incompatible (see Section 3.2, Noise for more details). Noise exposure from baseline airfield operations at Hickam AFB and Honolulu International Airport is shown in Figure 3.2-1. These contours provide a baseline against which to measure the projected change if the F-22A is based at Hickam AFB.

Existing and proposed HIANG land use includes the continued use of protective structures for F-15 and proposed F-22A aircraft.

The private land in the vicinity of Hickam AFB has a variety of land use designations. The land uses range from intensive industrial to general preservation. Mixed into the private lands are small parcels of unimproved residential that are owned by the City and County of Honolulu and used for schools. The land use designation for the Honolulu International Airport is intensive industrial district. A small pocket of industrial mixed use occurs on the northern end of the airport, immediately south of Interstate Route H-1 along Koapaka and Paiea Streets. North of Interstate Route H-1 is more area designated as intensive industrial with small areas of community business district. Further to the east and south of Dillingham Boulevard, the land use designations are variations of industrial in support of Honolulu harbor's industrial port. Sand Island has both industrial and general preservation district land uses (City and County of Honolulu 2007).

To the west of Hickam AFB across Mamala Bay are additional lands belonging to USNB Pearl Harbor, which are being used for base housing. Adjacent to the USNB Pearl Harbor land is the edge of the rapidly developing community of Ewa Beach and north of the beach, the unincorporated residential areas of Ewa Villages in Honolulu County. In this area the land uses are residential, unimproved residential used for schools (owned by the City and County of Honolulu), and community business district with some larger tracts of agriculture remaining (City and County of Honolulu 2007).

3.8.2.2 Transportation on Hickam AFB and Environs

Hickam AFB is accessed by Interstate Route H-1, Nimitz Highway (State Route 92), or Kamehameha Highway (State Route 99). The installation is within the Honolulu Primary Urban Center which has a well-developed road system. Access onto the installation is primarily through two gates: Main Gate and Porter Gate. Nimitz Highway terminates at the Main Gate where it is renamed O'Malley Boulevard. The Main Gate is at the northern edge of the installation and provides the primary gateway onto the installation. Porter Gate is located on the western side of the installation, but functions as a secondary gate since at least one other gate (staffed by the Navy) must be traversed prior to Porter Gate. Kuntz Gate, a third gate, provides restricted access to the base and the Honolulu International Airport.

The road system on Hickam AFB was originally designed in the mid-1930s. Over the years many new roads have expanded access to additional base areas (Figure 3.8-2). Primary roadways on Hickam AFB include O'Malley Boulevard, Vandenberg Boulevard, Freedom Avenue, and Kuntz Avenue. Secondary roadways that provide access to the other portions of base include Fox Boulevard, Signer Boulevard, Boquet Boulevard, and Porter Avenue. The southern portion of base, including the HIANG facility, is accessed via Fort Kamehameha Road and Mamala Bay Drive. The roads on Hickam AFB are in good condition due to the materials used (asphalt concrete) and the mild weather.

Circulation issues were identified in the General Plan (2006) at the Kuntz Road overpass and O'Malley Boulevard. Potential solutions for the bottleneck are identified in the focus area concept plans (components of the General Plan). The preferred solution is to establish a round-about large enough to handle a high volume of traffic at the intersections of O'Malley, Kuntz, and Vandenberg Boulevard (Air Force 2006c).

3.8.2.3 Recreation on Base and Under Military Training Airspace

Beach areas south of the HIANG area are used for recreational beach activities including swimming, snorkeling, boating, and other beach-related recreation. The beaches front Mamala Bay and provide a sheltered area for recreational activities. The sheltered beach areas are extensively used by military families and others with access to Hickam AFB. The Fort Kamehameha Historic District also includes trails and related recreation activities for persons with access to Hickam AFB.

Recreational trails and explanatory boards are part of the recreational opportunities associated with the Fort Kamehameha area.

Training by the F-22A would occur in the existing offshore Warning Areas at altitudes most commonly above 30,000 feet MSL. Recreational boating occurs under the large overwater training areas. Recreationists currently would experience the distant jet sound of F-15 training aircraft and could happen in the area of a sonic boom and experience the double crack of a sonic boom. More likely, recreationists would experience sonic booms as distant thunder.

The Northwestern Hawaiian Islands Marine National Monument and the Hawaiian Islands Humpback Whale National Marine Sanctuary are located outside of Warning Area airspace. No other special use areas are underneath the Warning Areas that would be utilized for training.

3.9 Socioeconomics

3.9.1 Definition of Resource

Socioeconomic factors are defined as the basic attributes and resources associated with the human environment. The relevant factors related to the proposed F-22A beddown at Hickam AFB include the following:

- Population and housing
- Economic activity
- Public services

Data for the socioeconomic analysis in this EA were obtained from a variety of sources, including the Air Force, the U.S. Bureau of the Census (USBC), the U.S. Bureau of Economic Analysis, and certain Hawaiian agencies as noted in this section.

Hickam AFB is situated in the City and County of Honolulu on the island of Oahu, Hawaii. The City and County of Honolulu includes the combined urban district of Honolulu census designated place (CDP) and the remainder of the island of Oahu. A CDP is a statistical entity comprising a dense concentration of population that is not within an incorporated place but is locally identified by a name. CDPs are delineated cooperatively with state and local and tribal government officials based on USBC guidelines.

Socioeconomic activities associated with the base are concentrated in Honolulu, which comprises the ROI for this analysis. Available socioeconomic characteristics are addressed for Hickam AFB and for Honolulu CDP and the County of Honolulu, which together comprise the City and County of Honolulu.

3.9.2 Hickam AFB and Environs

3.9.2.1 Population and Housing

Hickam AFB

The Hickam AFB population of 19,372 persons is comprised of 8,363 military personnel, 8,076 military family members, 1,417 appropriated fund civilian personnel, and 1,516 nonappropriated fund personnel (Air Force 2005b). During 2005, 2,760 military personnel and 5,151 associated family members resided in on-base housing, which includes personnel living in privatized family housing units. The remaining 8,536 base employees and their families presumably reside in off-base communities on Oahu.

The military family housing inventory at Hickam AFB includes 1,741 units, in addition to 1,356 privatized family housing units (Air Force 2005b). Unaccompanied permanent party housing at Hickam AFB consists of seven buildings with a total of 767 dormitory rooms. Housing for transient use includes nine Visiting Officer Quarters with a total 155 rooms, four Visiting Airmen Quarters with a total 115 rooms, plus an additional five temporary facilities with a total 153 spaces.

City and County of Honolulu

The 2005 population for Honolulu CDP was 362,252 persons. This figure includes the household population residing in Honolulu, and excludes persons living in institutions, college dormitories, and other group quarters. Honolulu CDP comprises 41.5 percent of the county population of 873,177 persons and 29.3 percent of the State of Hawaii population of 1,238,158 persons. Population in the region has grown 3.3 percent since 2000, compared to 5.3 percent growth for the state and for the nation as a whole (USBC 2005). Additional information regarding demographic characteristics of the population can be found in Section 3.10, Environmental Justice.

According to the Census, there were a total of 329,300 housing units in Honolulu County in 2005. The vacancy rate was 8.7 percent, and the homeownership rate was 52.6 percent. Honolulu CDP had 163,889 housing units, of which 10.9 percent were vacant and 44.4 percent were owner-occupied. The median value of owner-occupied homes in the county was $481,000. The average household size is 2.48 persons (USBC 2005).

3.9.2.2 Economic Activity

Hickam AFB

Hickam AFB makes a valuable contribution to the Honolulu economy through employment of military and civilian personnel and expenditures for goods and services from local businesses. In addition to base employment described above in Section 3.9.2.1, annual payroll associated with Hickam AFB personnel amounts to $516 million. In FY 2005, construction, service contracts, and purchases totaled $197 million. Hickam AFB activities are estimated to generate 4,984 indirect jobs in the region with associated wages totaling $183 million. The total economic impact of Hickam AFB is determined to be $731 million annually (Air Force 2005b).

City and County of Honolulu

Known globally as a premier tourist destination, the Honolulu economy is primarily driven by the state's considerable visitor industry. Hawaii and Honolulu County have broadened their economic base to include technology and knowledge-based industries, such as alternative energy, diversified agriculture, ocean and earth sciences, astronomy and other space sciences (Enterprise Honolulu 2007).

Tourism in Honolulu is a major factor in the region's economy.

The civilian labor force in Honolulu CDP included 180,908 persons in 2005, of which 174,465 were employed. The unemployment rate in 2005 was 3.6 percent. Median household income was $50,793 and persons below the poverty level represent 12.0 percent of the population. In the Honolulu County, 401,075 persons were employed, and the unemployment rate in 2005 was 4.4 percent

3.9.2.3 Public Services

Daily operation of Hickam AFB, and furnishing of services and support to base personnel and family members, is the responsibility of 15 AW, the base host unit. Off-base public services are provided by a number of public and private entities. Police and fire protection are principally provided by the Honolulu Police and Fire Departments, respectively. The City and County of Honolulu are served by eight major hospitals, the largest being Queen's Medical Center in downtown Honolulu. The 15th Aeromedical-Dental Squadron runs a dental and medical clinic on Hickam AFB. Medical services for military personnel and their families also may be obtained at Tripler Army Medical Center in Honolulu.

Public schools serving the Hickam AFB community include Hickam Elementary School (located on base), Mokulele Elementary School, Nimitz Elementary School, Aliamanu Middle School, and Radford High School. Total enrollment at these schools during the 2005-2006 school year was 3,675 students (Hawaii Department of Education [DOE] 2006). A number of independent, private schools also are available in the Honolulu area. The Hawaii DOE receives federal impact aid for military family members attending local public schools. In 2004, Hawaii DOE was anticipated to receive $2,400 annually for each child residing on base and $420 dollars for each military child living in off-base housing (Honolulu Advertiser 2003).

3.10 Environmental Justice

3.10.1 Definition of Resource

Concern that certain disadvantaged communities may bear a disproportionate share of adverse health and environmental effects compared to the general population led to the enactment in 1994 of EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*. This executive order directs federal agencies to address disproportionate environmental and human health effects in minority and low-income communities. EO 13045, *Protection of Children from Environmental Health Risks and Safety Risks*, was enacted in 1997, directing federal agencies to identify and assess environmental health and safety risks to children, coordinate research priorities on children's health, and ensure that their standards take into account special risks to children.

For purposes of this analysis, minority, low-income and youth populations are defined as follows:

- Minority Population: Alaska Natives, American Indians, Asians, Blacks, Native Hawaiians and Pacific Islanders, or persons of Hispanic origin (of any race).
- Low-Income Population: Persons living below the poverty threshold as determined by the USBC.
- Youth Population: Children under the age of 18 years.

Estimates of these three population categories were developed based on data from the USBC. The Census does not report minority populations, per se, but reports population by race and by ethnic origin. Low-income and youth populations were drawn from the USBC 2005 American Community Survey.

Hickam AFB is situated in the City and County of Honolulu on the island of Oahu, Hawaii. The City and County of Honolulu includes the combined urban district of Honolulu CDP (census designated place) and the remainder of the island of Oahu. A CDP is a statistical entity comprising a dense concentration of population that is not within an incorporated place but is locally identified by a name. CDPs are delineated cooperatively with state and local and tribal government officials based on USBC guidelines. Environmental Justice populations are addressed for Honolulu CDP and the County of Honolulu. For comparative purposes, Environmental Justice data for the State of Hawaii and the United States also are presented.

3.10.2 Hickam AFB and Environs

To comply with EO 12898, ethnicity and poverty status in the vicinity of Hickam AFB were examined and compared to state and national data. Minority persons represent 82.5 percent of the Honolulu CDP population, compared to 81.0 percent of the county and 77.0 percent of the state (see Table 3.10-1). Asians comprise the predominant minority group, accounting for 58.6 percent of the Honolulu CDP population, 47.7 percent of the county population and 42.0 percent of the state (includes persons reporting only one race). Native Hawaiians and other Pacific Islanders account for 6.3 percent of the Honolulu CDP population, 8.3 percent of the county and 8.5 percent of the state. While the aggregate racial and ethnic minority population represents a numerical majority of the population, their incidence is relatively consistent throughout the region and is not disproportionate within the vicinity of Hickam AFB.

Table 3.10-1. Total Population and Populations of Concern

	Total Population	*Percent Minority*	*Percent Low-Income*	*Percent Youth*
Honolulu CDP	362,252	82.5	12.0	18.4
Honolulu County	873,177	81.0	9.4	23.8
State of Hawaii	1,238,158	77.0	9.8	24.1
United States	281,421,906	30.9	12.4	25.7

Source: USBC 2005

The low-income population in the Honolulu CDP is slightly higher than county and state levels, but comparable to the national level. In the Honolulu CDP, 12.0 percent of the population is comprised of persons and families with incomes below the poverty level. By comparison, low-income population rates for the county and state are 9.4 percent and 9.8 percent respectively. The low-income population is higher in the city than in the county as a whole.

To comply with EO 13045, the number of children under age 18 was determined for the vicinity of Hickam AFB and compared to state and national levels. The youth population in the Honolulu CDP is relatively low, with no known concentrated areas of concern where youth might experience special health or safety risks. Children under 18 years in the Honolulu CDP account for 18.4 percent of the population compared to 23.8 percent and 24.1 percent in Honolulu County and Hawaii, respectively.

4.0 POTENTIAL ENVIRONMENTAL CONSEQUENCES ON HICKAM AIR FORCE BASE AND IN TRAINING AIRSPACE

This chapter analyzes potential environmental consequences from the replacement of HIANG F-15 aircraft with F-22A aircraft at Hickam AFB.

Resource sections generally include attributes and any applicable regulations. The expected geographic scope of potential environmental consequences is identified as the ROI. Depending on the resource, the ROI may be defined as the installation, or the City and County of Honolulu. For the airspace, the ROI may be defined as the outermost boundary of potential environmental consequences. Offshore Warning Areas and ATCAAs were considered for resources with the potential to be affected.

This chapter considers the direct and indirect effects of the proposed replacement of F-15 aircraft with F-22A aircraft and the No Action Alternative described in Chapter 2.0 of this EA. The *Existing Conditions* (refer to Chapter 3.0) of each relevant environmental resource is described to give the public and agency decision-makers a meaningful point from which they can compare potential future environmental, social, and economic effects. Cumulative effects are discussed in Chapter 5.0.

4.1 Airspace Management

The potential effects of the replacement of the F-15 aircraft with F-22A aircraft on the airspace environment were assessed by considering the changes in airspace utilization that would result from the implementation of the alternatives. This assessment considered compliance with AFI 13-201 (*Air Force Airspace Management)* and supplements thereto, as well as measures that could minimize potential impacts on other regional air traffic and the ATC system.

The type, size, shape, and configuration of individual airspace elements in a region are based upon, and are intended to satisfy, competing aviation requirements. Potential impacts could occur if air traffic in the region and/or the ATC systems were encumbered by changed flight activities associated with the proposed replacement. When a new or revised defense-related activity within an airspace area or a change in the complexity or density of aircraft movements is proposed, the FAA reassesses the airspace configuration. The FAA seeks to determine if such changes could adversely affect ATC systems and/or facilities; movement of other air traffic in the area; or airspace already designated and used for other purposes supporting military, commercial, or general aviation.

Airspace managers at the Honolulu/Hickam airfield have supported military fighter aircraft, such as these F-15s, for decades.

4.1.1 Proposed Action

Base. Under the Proposed Action, F-22A aircraft would replace the F-15 aircraft currently assigned to the 199th Fighter Squadron (199 FS) at Hickam AFB. No changes or modifications to the controlled airspace or ATC procedures currently supporting aviation activities at Honolulu International Airport are required to support this action. Within the airfield environment, F-22As would fly comparably to the existing F-15s. The F-22A has approximately the same size and airfield performance as the F-15. In coordination with the FAA, the HIANG has developed and tested F-22A arrival procedures, which would reduce the potential for noise impacts to off-base locations.

The three additional PAI F-22A aircraft plus the increased operations associated with the F-22A, as compared with the F-15, would increase the average daily military operations from 53 to 65 operations. Currently, there are 880 average daily Honolulu-Hickam operations, including military and civilian operations. The increased number of airfield operations associated with the F-22A would constitute approximately 1.2 percent of the current Honolulu-Hickam airfield operations. This change would not be expected to noticeably increase the workload of ATCs responsible for airfield traffic.

Airspace. The current mission assigned to the 199 FS is that of air superiority. As such, all of their training focuses on air-to-air combat. This, too, would remain the primary training accomplished with the proposed F-22A replacements. There would be no changes in the military training airspace in the region and there would be no change in the use or training activities conducted in the airspace. Use of the Warning Areas and ATCAAs described in Section 3.1 would continue. Table 4.1-1 presents the existing and proposed airspace usage for HIANG training. As noted in Section 2.3.1, the cumulative ATCAA use would represent approximately 5 percent of F-22A training.

Table 4.1-1. Baseline F-15 and Projected F-22A Annual Sortie-Operations in Warning Areas

Warning Area	Baseline	Projected
	F-15	*F-22A*
188	1,076	1,620
189	2,153	3,240
190	1,076	1,620
192	240	360
193	240	360
194	240	360

The F-22A training would increase the number of sortie-operations in the Warning Areas currently used for training from a total of 5,052 F-15 sortie-operations to a total of 7,560 F-22A sortie-operations. This increase would not be expected to create increased airspace management requirements for military airspace schedulers or for FAA ATC personnel responsible for routing the training aircraft from Hickam to the Warning Areas.

Although the 199 FS would assume an air-to-ground mission after the conversion, ordnance delivery would only be accomplished at off-site locations. The F-22A would not use Hawaiian MTRs or training ranges for low-level or air-to-ground training.

4.1.2 No Action Alternative

Under the No Action Alternative, the aircraft conversion would not occur, and aviation activities at Hickam AFB would continue unchanged. Airspace management and air traffic control would remain as described in Section 3.1, and no impacts would be expected.

4.2 Noise

Noise associated with aircraft operations at Hickam AFB/Honolulu International Airport and the surrounding training airspace, other transportation-related noise, and construction activities associated with the Proposed Action is considered in this section and compared with the baseline conditions described in Section 3.2 to assess potential impacts. Data developed during this process also supports analyses in other resource areas.

Based on numerous sociological surveys and recommendations of federal interagency councils, the most common noise-related benchmark referred to is an L_{dn} of 65 dBA. This threshold is often used to determine residential land use compatibility around airports, highways, or other transportation corridors. Two other average noise levels are also useful:

- An L_{dn} of 55 dBA was identified by the USEPA as a level ". . . requisite to protect the public health and welfare with an adequate margin of safety" (USEPA 1974). Noise may be heard, but there is no risk to public health or welfare.
- An L_{dn} of 75 dBA is a threshold above which effects other than annoyance may occur. It is 10 to 15 dBA below levels at which hearing damage is a known risk (OSHA 1983). However, it is also a level above which some adverse health effects cannot be categorically discounted.

In terms of impulsive noise, OSHA has established a maximum permissible exposure level of 140 dBC (29 CFR § 1910.95).

Public annoyance is the most common impact associated with exposure to elevated noise levels. When subjected to L_{dn} of 65 dBA, approximately 12 percent of persons so exposed will be "highly annoyed" by the noise. At levels below 55 dBA, the percentage of annoyance is correspondingly lower (less than 3 percent). The percentage of people annoyed by noise never drops to zero (some people are always annoyed), but at levels below 55 dBA it is reduced enough to be essentially negligible.

4.2.1 Proposed Action

Commercial aviation-related noise would continue to be the dominant noise source in the ROI's acoustic environment. Under the Proposed Action, transient military and civil aircraft operations at Honolulu International Airport/Hickam AFB would not change appreciably from current conditions. The 199 FS would change missions and convert from F-15 aircraft to F-22A aircraft. Also, the 199 FS would build new facilities, demolish facilities, and upgrade other aspects of the installation's supporting infrastructure. There are several aspects of this proposal that have the potential to alter the acoustic environment in the ROI.

Under the Proposed Action, the 199 FS would increase their aircraft inventory, resulting in a slight increase in flight operations. Overall, daily flight activity at the airfield would increase from approximately 880 operations to approximately 892 operations (a 1.4 percent increase). Table 4.2-1 reflects this change.

Table 4.2-1. Average Daily Operations At Hickam AFB/Honolulu International Airport After Conversion[1]

Aircraft	Arrivals		Departures		Closed Patterns		Total
	Day	*Night*	*Day*	*Night*	*Day*	*Night*	
F-22A	15.851	2.144	17.994	0.000	0.000	0.000	35.989
C-17	3.000	0.000	3.000	0.000	0.003	0.000	6.006
KC-135R	2.24	0.061	2.301	0.000	0.000	0.000	4.602
Transient Military	7.768	1.558	7.790	1.537	0.000	0.000	18.653
Civil	377.882	30.674	367.202	41.372	9.544	0.000	826.674
Total	406.741	34.437	398.287	42.909	9.550	0.000	891.924

Note: 1. Daily operations are based on averages of annual operations; therefore, numbers do not round.

Aircraft noise levels resulting from this conversion are compared with baseline levels in Figure 4.2-1. Points of Interest in relation to the proposed noise contours are depicted on Figure 4.2-2. Table 4.2-2 compares the contributions of Civil, Other Based Military, and Transient Military operations with F-15 and F-22A operations impacting specific points on the Ewa peninsula. The modeled noise contours reflect the HIANG proposed adjustments to approach patterns to apply noise avoidance approach procedures to approximately 85 percent of the F-22A arrivals. These data demonstrate that the noise environment is dominated by flight operations other than either the F-15 or the F-22A aircraft. The land areas encompassed by these levels are compared with current levels in Table 4.2-3.

Table 4.2-2. Aircraft Noise Contribution to Representative Locations on the Ewa Peninsula

Point ID	Description	Baseline				
		Civilian	*KC-135*	*Transient Military and C-17*	*F-15*	*Total*
P5	Iroquois Point Elementary School	61.9	38.0	58.6	53.1	64.0
P12	Residential (108 Street)	66.4	41.1	62.4	55.2	68.1
P13	Residential (Iroquois Drive)	66.2	41.2	62.3	55.4	67.9
P14	Tip of Baseline 65 Contour	63.6	36.8	58.5	52.3	65.0
P15	Campbell High School	50.9	28.1	46.8	46.4	53.3
Point ID	*Description*	**Proposed Action**				
		Civilian	*KC-135*	*Transient Military and C-17*	*F-22A*	*Total*
P5	Iroquois Point Elementary School	61.9	38.0	58.6	50.0	63.8
P12	Residential (108 Street)	66.4	41.1	62.4	51.8	68.0
P13	Residential (Iroquois Drive)	66.2	41.2	62.3	52.9	67.8
P14	Tip of Baseline 65 Contour	63.6	36.8	58.5	46.1	64.8
P15	Campbell High School	50.9	28.1	46.8	45.9	53.2

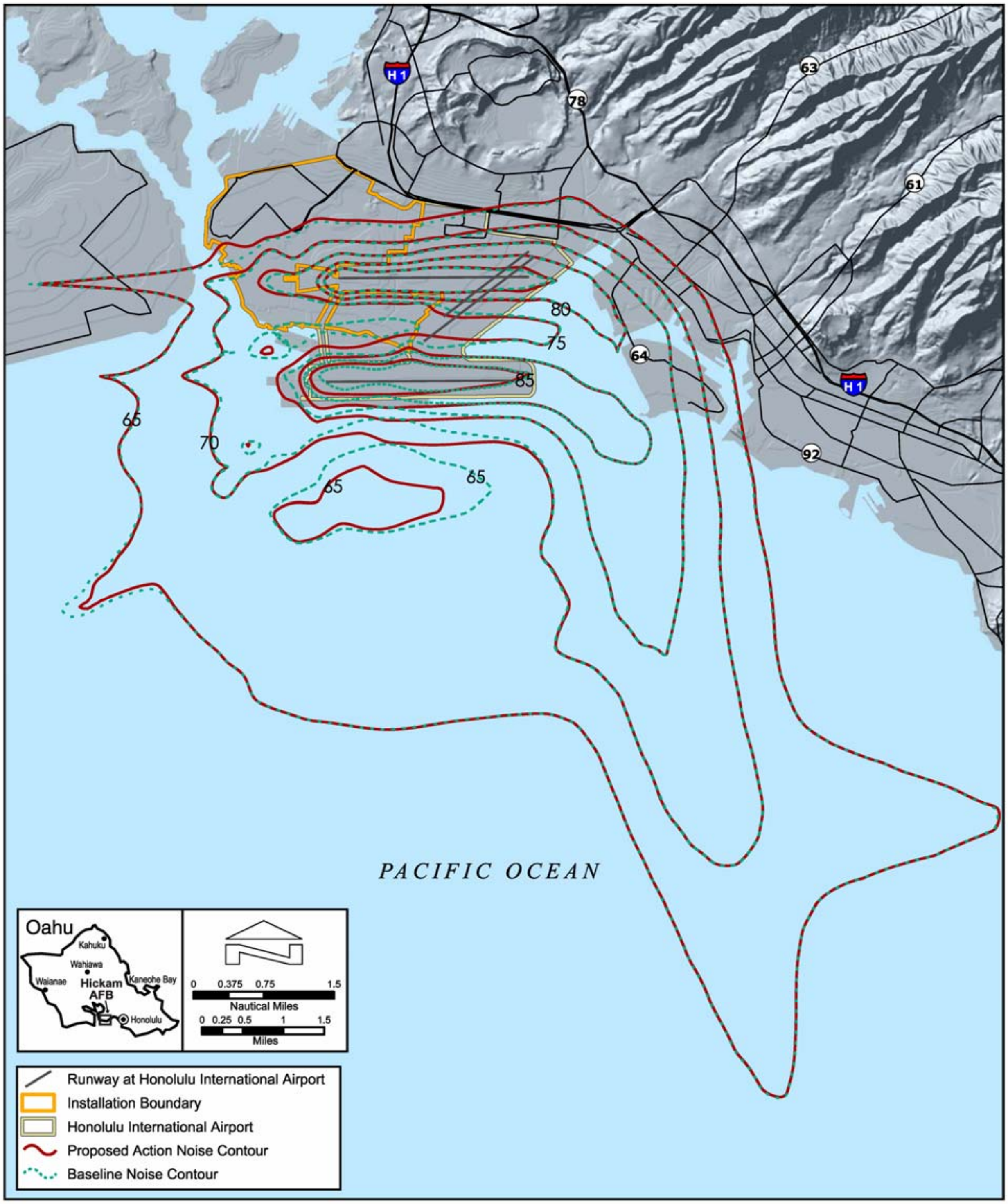


Figure 4.2-1. Comparison of Baseline and Proposed F-15 and F-22A Noise Contours

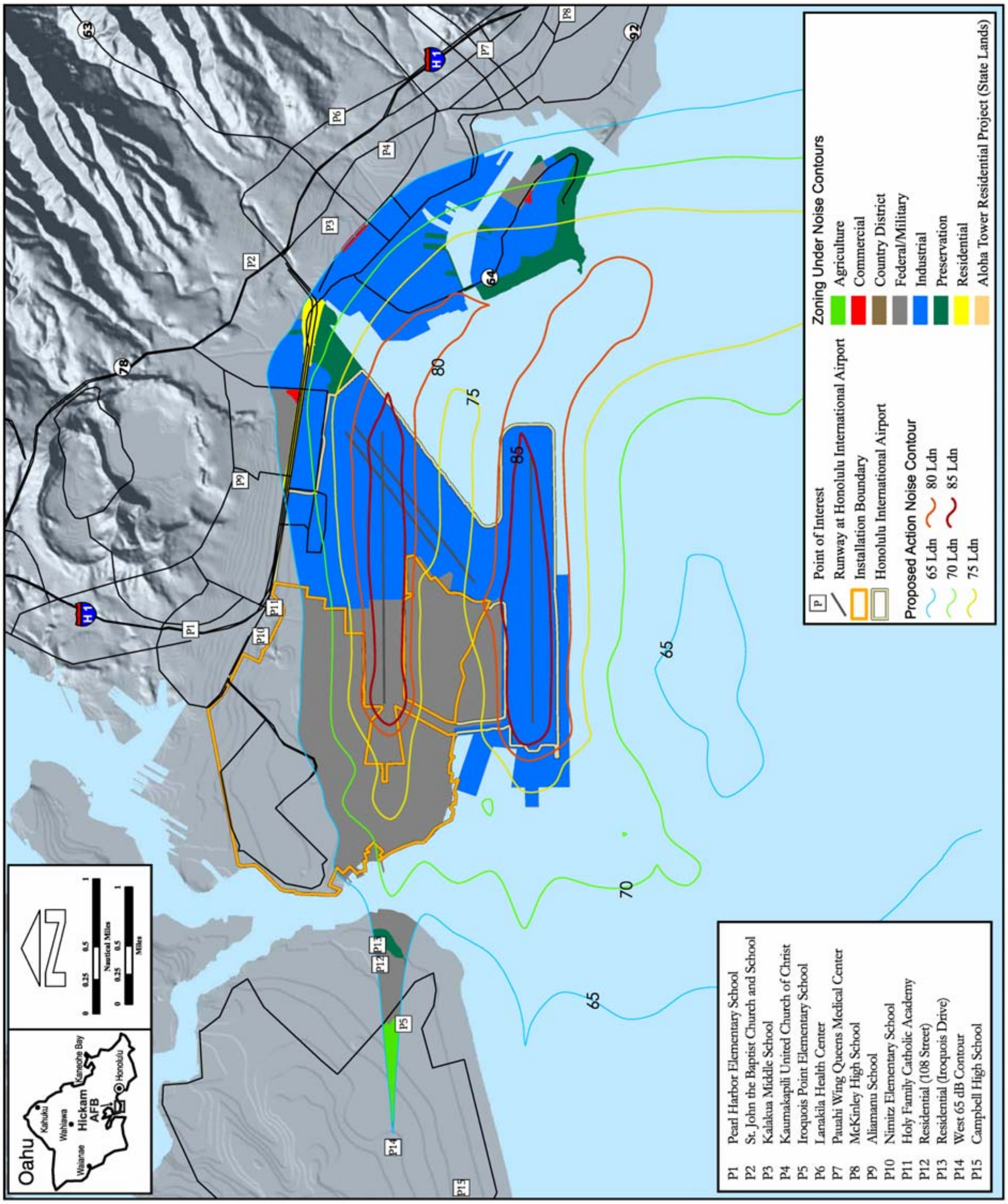


Figure 4.2-2. Proposed Action Noise Contours and Points of Interest

Table 4.2-3. Land Area under Baseline and Proposed Noise Contours

Noise Level (In L_{dn})	Baseline				Proposed Action			
	Installation[1] Land Acres		Installation Water Acres		Installation Land Acres		Installation Water Acres	
	Off	*On*	*Off*	*On*	*Off*	*On*	*Off*	*On*
60 – 65	0	0	1,275	0	0	0	662	0
65 – 70	1,113	561	17,290	4	1,077	541	17,414	3
70 – 75	686	1,086	5,836	10	650	1,091	6,500	11
75 – 80	644	632	2,735	1	622	722	2,869	2
80 – 85	93	782	891	6	224	685	903	6
> 85	0	831	1	0	3	975	1	0
Total	2,536	3,892	28,028	21	2,576	4,014	27,969	22

Note: 1. Installation includes Hickam AFB and Honolulu International Airport.

As shown, overall noise exposure around Hickam AFB/Honolulu International Airport would increase under the Proposed Action. However, these increases are minimal. As shown in Table 4.2-4, noise exposure at the Points of Interest locations reflects minor changes.

Table 4.2-4. Specific Point Noise Exposure under Aircraft Conversion

ID[1]	*Name*	*Baseline (L_{dn})*	*Proposed (L_{dn})*
P1	Pearl Harbor Elementary School	55.2	55.6
P2	St. John the Baptist Church and School	58.7	59.0
P3	Kalakua Middle School	61.9	62.2
P4	Kaumakapili United Church of Christ	60.5	60.8
P5	Iroquois Point Elementary School	64.0	63.8
P6	Lanakila Health Center	55.8	56.2
P7	Pauahi Wing Queens Medical Center	57.5	57.9
P8	McKinley High School	57.1	57.4
P9	Aliamanu School	60.5	60.8
P10	Nimitz Elementary School	60.0	60.8
P11	Holy Family Catholic Academy	61.0	61.9
P12	Residential (108 Street)	68.1	68.0
P13	Residential (Iroquois Drive)	67.9	67.8
P14	West 65 dB Contour	65.0	64.8
P-15	Campbell High School	53.3	53.2

Under the Proposed Action, the FAA and HIANG continue to work together to meet the needs of both agencies and identify workable solutions for the F-22A as they have done with the F-15.

While F-22A specific procedures have yet to be developed, there are currently approved F-15 practices that minimize noise impacts on surrounding communities and the HIANG will work with the FAA to leverage that experience when developing F-22A procedures. Examples of HIANG and FAA coordination include the FAA-approved HIANG procedure that brings all fighter aircraft into Runway 4R for night operations and current FAA procedures which outline using Runway 4R in lieu of channel approaches to Runway 8L for commercial aircraft to reduce potential noise impacts to surrounding communities.

Construction would most likely occur over an extended time-frame, and at any one time, only a small number of projects would be expected to be ongoing. Therefore, noise associated with active construction sites would be expected to be intermittent and of relatively limited duration. A hypothetical scenario was developed to assess potential noise associated with construction activities on a construction site. Primary noise sources during such activity would be expected to be heavy vehicles and earth-moving equipment. Table 4.2-5 shows sound levels associated with typical heavy construction equipment under varying modes of operation.

Table 4.2-5. Typical Equipment Sound Levels

	Sound Level (in dBA) Under Indicated Operational Mode[1]		
Equipment	*Idle Power*	*Full Power*	*Moving Under Load*
Forklift	63	69	91
Backhoe	62	71	77
Dozer	63	74	81
Front-End Loader	60	62	68
Dump Truck	70	71	74

Note: 1. Measured at 125 feet.
Source: Air Force 1998

For the assessment of construction noise, a hypothetical "construction area" was designated that approximated the estimated area that would be involved in supporting a major project under the proposal.

The first step in the analysis was to estimate equipment usage and calculate the total acoustic energy that would be expected to be generated on the site. These data also provided information on an individual piece of equipment's relative contribution to the total amount of acoustic energy generated on the site. Next, individual equipment was spatially distributed throughout the construction zone considering "most likely" areas of operation. This yielded an equipment-weighted contribution to total site acoustic energy at different points throughout the site. With this spatial distribution, it was then possible to calculate a mean and standard deviation for the distribution along an axis running through the site.

These data were then used to normally distribute the total site energy throughout the site. Finally, the normally distributed energy from multiple source points throughout the site was aggregated at a range of points at varying distances from the site edge. This allowed a determination at those points of the total acoustic energy that had emanated off-site.

Calculations based on this conservative scenario indicate an equivalent noise level over an $L_{eq(8)}$ of 67 dBA at a distance of 500 feet from the edge of the site. This is then normalized to an equivalent noise level over an $L_{eq(24)}$ of 62 dBA. Since no construction activity would be expected to occur at night, this would be equivalent to L_{dn} 62. At a distance of 1,000 feet from the site, noise levels are $L_{eq(8)}$ 62 dBA and $L_{eq(24)}$ 58 dBA. Due to the conservative nature of the scenario, and the fact that sound attenuation only due to spherical spreading was considered, actual levels emanating off-site would be expected to be lower.

It should be noted that the areas involving construction are situated within areas already exposed to elevated noise from airfield operations. All projects are located in or immediately proximate to the airfield. These areas are well within the L_{dn} 65 contour created by aircraft noise. Construction noise emanating off-site would probably be noticeable in the immediate site vicinity, but would not be expected to create adverse impacts, or alter noise contours associated with aircraft operations. Furthermore, construction-related noise is intermittent and transitory, ceasing at the completion of construction. The long-term acoustic environment at the airfield would not be expected to be influenced by construction activities, and would continue to be dominated by aviation activities.

Aircraft-generated noise within the military training airspace used by the 199 FS would also be modified. As noted in Section 2.3, incidental F-22A instrument/arrival procedure training comparable to that of the F-15 would occur at outlying fields, such as Kaneohe Marine Corps Base Hawaii. Table 3.2-1 demonstrates that the L_{max} noise levels of the F-22A are comparable to those of the F-15 on departure and louder than the F-15 on arrival. The intermittent nature of F-22A procedure training at these locations would not measurably change the noise levels at the airfield from existing conditions. A resident near the departure pattern would not be expected to detect any noticeable difference between the F-15 and F-22A. A resident near the approach pattern to these fields could detect the noise difference between an incidental F-15 instrument/arrival and that of a louder F-22A.

Subsonic and supersonic flight activities will continue to be conducted in the over-water offshore Warning Areas surrounding the island of Oahu.

Within the Warning Areas, subsonic flight is dispersed and usually occurs randomly. The Air Force has developed the MR_NMAP (MOA-Range NOISEMAP) computer program (Lucas and Calamia 1996) to calculate subsonic aircraft noise in these areas. Under the Proposed Action, the most intensely-used Warning Area would continue to be W-189. Approximately 3,000 F-22A sorties would be conducted in W-189 annually. Although the F-22A creates more noise than the F-15, the higher altitude regimes in which the F-22A is operated minimizes this impact. Calculations of noise in W-189 reflect an increase in noise levels from 34.4 L_{dnmr} to 38.3 L_{dnmr}. This level essentially remains at, or below what would ordinarily be considered ambient. Some noise may be heard, but it would not be considered intrusive. Operations in all other Warning Areas are considerably less and would have less of a noise affect.

Supersonic activity will continue to be authorized in the offshore Warning Areas. As previously discussed, the amplitude of an individual sonic boom is measured by its peak overpressure, in psf and depends on an aircraft's size, weight, geometry, Mach number, and flight altitude. The biggest single condition influencing boom amplitude is altitude. Table 4.2-6 shows sonic boom overpressures for the F-15 and F-22A aircraft in level flight at various altitudes, and relates these overpressures to a sound exposure level.

Table 4.2-6. Sonic Boom Peak Effects for F-15 and F-22A Aircraft at Mach 1.2 Level Flight

Aircraft	Altitude (In Feet)			
	10,000	***20,000***	***30,000***	***40,000***
Overpressure (in psf)				
F-15	5.40	2.87	1.90	1.46
F-22A	5.68	3.00	1.97	1.50
C-Weighted Sound Exposure Level [1]				
F-15	116.6	111.2	107.6	105.3
F-22A	117.1	111.5	107.9	105.5
Percent Change In Acoustic Energy				
F-22A v. F-15	+ 12%	+ 7%	+ 7%	+ 5%

Note: 1. Calculated by: CSEL = 102 + (20 X log (psf))

While the amplitude of individual sonic booms would be expected to increase, all noise levels remain well below the OSHA-established limit of 140 dBC.

F-22A training aircraft spend approximately 25 percent of their time flying supersonically as compared with 7.5 percent supersonically with current F-15 training. This supersonic activity produces a greater number of sonic booms in water areas under the training airspace.

The potential detectability of sonic booms would depend upon the intersection of the training aircraft flying at supersonic speeds and the distribution of boats under the airspace. In any given area under W-189, some sonic booms could be detected during current F-15 training and projected F-22A training. Under W-189, the water surface area could experience an estimated 21 sonic booms during an average month. Some of the booms would have the characteristic bang-bang sonic boom and some would have the impulse sound of distant thunder. The potential number of F-22A-caused sonic booms under the center of any of the other overwater airspaces would be less than that experienced under W-189.

The experience of a sonic boom would be unlikely for a recreationist under the airspace, but could occur. Such an experience could be startling and could result in annoyance, but sonic booms would not be of an overpressure, frequency, or intensity that could result in a significant impact.

4.2.2 No Action Alternative

Under this alternative, neither the aircraft conversion nor the proposed construction activities would occur. Noise associated with aircraft operations at and around Hickam AFB/Honolulu International Airport would remain as described in Section 3.2. Because no construction would occur, the noise associated with such activities would not occur.

4.3 Safety

Ground, flight, and explosive safety impacts are assessed according to the potential to increase or decrease safety risks to personnel, the public, and property. Proposal-related activities are considered to determine if additional or unique safety risks are associated with their undertaking. If any proposal-related activity indicated a major variance from existing conditions, it would be considered a safety impact.

4.3.1 Proposed Action

Under the Proposed Action, the 199 FS would convert from the F-15 aircraft to the F-22A aircraft. To support this conversion, improvements, modifications, and other changes to facilities and the unit's supporting infrastructure will be required.

Ground Safety. Providing new facilities that are properly sited with adequate space and a modernized supporting infrastructure would generally enhance safety during the conduct of required training, maintenance and support procedures, security functions, and other daily operations conducted by the unit in support of the aircraft conversion.

Improvements to maintenance and other support facilities, providing improvements, an enhanced work environment, and increased maintenance efficiency, would provide positive ground and flight safety impacts. Overall, in combination, the construction of new facilities, modifications/alterations to existing facilities, and demolition of outdated facilities would be expected to address outstanding ground, AT/FP, explosive, and flight safety considerations at the unit.

Activities involved in the proposed facility construction, modification, and demolition are not unique. Standard building and construction procedures and BMPs would be followed by the construction contractor(s).

Implementation of the Proposed Action would involve ground activities that may expose workers performing the required site preparation, grading, and building construction to some risk. The U.S. Department of Labor (DOL), Bureau of Labor Statistics maintains data analyzing fatal and non-fatal occupational injuries based on occupation. Due to the varying range of events classified as non-fatal injuries, the considerations described below focus on fatal injuries, since they are the most catastrophic. Data are categorized as incidence rates per 100,000 workers employed (on an annual average) in a specific industry (Standard Industrial Code [SIC]).

To assess relative risk associated with this proposal, it was assumed that the industrial classifications of workers involved are the Construction Trades (SIC-15, 16, and 17). Based on DOL data and considerations of worker exposure, the probability of a fatal injury would be statistically predicted to be from 1.2 to 3.1 out of 10,000 (DOL 2000). Although DoD guidelines for assessing risk hazards would categorize the hazard category as "catastrophic" (because a fatality would be involved), the expected frequency of the occurrence would be considered remote (MIL-STD-882 1993). While the potential result must be considered undesirable, risk is low. Strict adherence to all applicable occupational safety requirements would further minimize the relatively low risk associated with these construction activities.

Flight Safety. The F-22A is a new aircraft, and has accumulated very few flight hours. For example, F-15 aircraft, which have been flown since 1972, have accumulated more than 4,998,100 flight hours. By comparison, F-22A aircraft have flown only 3,246 hours (Air Force Safety Center 2006). Because mishap rates are statistically assessed as an occurrence rate per 100,000 flying hours, low use levels substantially influence the mishap rate. As a weapons system matures and the technicians who maintain it become more experienced, mishap rates are reduced and maintain a relatively constant level.

A Class A mishap rate cannot be calculated for a weapons system in development. During test and weapons development, F-22A aircraft have lost one aircraft. This is not unusual for a new, very complex weapons system. As the F-22A matures, it is reasonable to expect that the F-22A weapon system will be comparable the mishap rate of the comparably sized F-15.

Since overall aircraft exposure would be expected to remain relatively constant, risks associated with wildlife-aircraft strikes around Hickam AFB would remain as described in Section 3.3.

The HIANG and FAA are coordinating on F-22A arrival procedures with modifications to flight tracks to reduce the potential for noise impacts. These modified arrival procedures are being tested with F-15 aircraft to insure safety during airfield approach and departure. No safety impact would be anticipated with these modified F-22A arrival procedures.

Ordnance Safety. Although the 199 FS will assume both an air-to-ground and air-to-air mission with the aircraft conversion, no air-to-ground ordnance will be expended during training in Hawaiian airspace. Air-to-air ordnance is used from Hickam AFB to accomplish the HIANG Hawaiian Islands protection mission. Air-to-air ordnance is also used for live training exercises at the Pacific Missile Range. Air-to-air munitions would continue to be stored at Hickam AFB for the HIANG mission and would be used for F-22A missions as they are currently used for F-15 missions.

The F-22A QD arc for explosive safety extends beyond the QD arc associated with the F-15. The quantity-distance (QD) arc is calculated based on the spread of materials from an accidental explosion. The F-22A carries the same munitions internally as the F-15 does externally. An internal explosion is calculated to spread more materials, including parts of the aircraft, over a larger area. The F-22A QD arc (758 foot radius) is larger than the F-15 QD arc (400 foot radius). The additional area within the expanded QD arc would require an updated Explosive Site Plan in accordance with AFI 91-201, Chapter 4 that will account for this extension and its impact to surrounding work areas.

Air-to-ground ordnance would be delivered at off-site ranges during deployment. Chaff and flares would continue to be expended in the overwater training airspace, although at lower levels than under current conditions. The same safety procedures for handling chaff and flares currently enforced would continue in effect.

Implementation of the Proposed Action would not result in adverse impacts to safety.

4.3.2 No Action Alternative

Under the No Action Alternative, the 199 FS would not build any new facilities, nor improve the installation's infrastructure, and continue to operate F-15 aircraft. They would continue operations and maintenance activity using existing facilities. The safety enhancements that would be expected to result from the construction of the proposed new facilities would not be realized. The F-15 would continue to expend chaff and flares during training missions.

4.4 Air Quality

Air emissions resulting from the Proposed Action were evaluated in accordance with federal, state, and local air pollution standards and regulations. The air quality impacts from a proposed activity or action would be significant if they:

- increase ambient air pollution concentrations above any NAAQS;

- contribute to an existing violation of any NAAQS;
- interfere with or delay timely attainment of NAAQS; or
- impair visibility within any federally mandated PSD Class I area.

The approach to the air quality analysis was to estimate the increase in emission levels due to the Proposed Action and any alternatives under consideration and then compare those against the thresholds for determining whether a source is considered major under Hawaii regulations (HAR §11-60.1-1). As discussed in Section 3.4, a major source is defined as a source that emits more than 100 TPY of any one criteria air pollutant, 10 TPY of a hazardous air pollutant, or 25 TPY of any combination of hazardous air pollutants.

As previously discussed, Section 169A of the CAA established the PSD regulations to protect air quality in regions that already meet the NAAQS. Certain national parks, monuments, and wilderness areas have been designated as PSD Class I areas, where appreciable deterioration in air quality is considered significant. The nearest PSD Class I area is Haleakala National Park, which is approximately 120 miles to the east-southeast of Hickam AFB. Since the project site is such a long distance away from this Class I area, the Proposed Action would produce less then significant air quality impacts to this area.

4.4.1 Proposed Action

Construction Emissions. Emissions during the construction period were quantified to determine the potential impacts on air quality in the project area. Calculations of volatile organic compounds (VOCs), nitrogen oxides (NO_x), CO, sulfur oxides (SO_x), PM_{10}, and $PM_{2.5}$ emissions were performed with the use of emission factors from the USEPA's *NONROAD2005 and MOBILE6.2* models (USEPA 2006a, 2006b). Emissions as result of building construction include contributions from engine exhaust (i.e., construction equipment and material handling) and fugitive dust (e.g., from ground disturbance). Demolition emissions evaluated include contributions from engine exhaust (i.e., construction equipment and material handling), fugitive dust and transport of demolition debris off site. Paving emissions consist of combustive emissions from bulldozers, rollers, and paving equipment, and emissions from dump trucks hauling pavement materials to the site. Estimated total emissions that would occur from demolition, construction, and paving activities under the Proposed Action are presented in Table 4.4-1. These total emissions would occur over the duration of the construction period. For the most conservative analysis possible, all construction is assumed to occur during one calendar year. However, it is likely that this project would actually take a number of years to complete. As a result, actual annual construction emissions would be lower then the totals presented in Table 4.4-1.

Table 4.4-1. Construction Emissions – Proposed Action

Source	Emissions (in Tons)					
	VOC	*CO*	*NO_x*	*SO_x*	*PM_{10}*	*$PM_{2.5}$*
Demolition	0.28	1.21	2.35	0.29	1.04	0.37
Construction	0.56	3.33	5.44	0.82	2.78	1.04
Paving	0.01	0.06	0.17	0.02	0.49	0.11
Total	0.56	3.33	5.44	0.82	2.78	1.04
NEPA Significance Threshold	100	100	100	100	100	100

Emissions generated by demolition, construction, and paving projects are temporary in nature and would end when construction is complete. Additionally, the project construction contractor would comply with *HAR §11-60.1-33 - Fugitive Dust* (State of Hawaii Department of Health 2003), to minimize fugitive dust emissions during construction. For instance, frequent spraying of water on exposed soil during construction, proper soil stockpiling methods, and prompt replacement of ground cover or pavement are standard landscaping procedures that could be used to minimize the amount of dust generated during construction. Using efficient practices and avoiding long periods where engines are running at idle may reduce combustion emissions from construction equipment. Vehicular combustion emissions from construction worker commuting may be reduced by carpooling.

Project construction would emit hazardous air pollutants that could potentially impact public health. Hazardous air pollutants generally are minor subsets of VOC and PM_{10} emissions. Review of Table 4.4-1 shows that the Proposed Action would produce a maximum annual total of 0.62 tons of VOC and 3.07 tons of PM_{10}. Therefore, emissions from construction will not exceed 10 TPY of any hazardous air pollutant or 25 TPY of combined hazardous air pollutants.

Emissions associated with construction of the Proposed Action would increase ambient air pollutant concentrations on a localized and short-term basis. However, since these emissions would not surpass any significance threshold, they would not result in any significant air quality impacts in Honolulu County or the State of Hawaii AQCR (AQCR 60).

Operational Emissions. Upon completion of the Proposed Action, air emissions at the Hickam AFB would change because the new aircraft would produce emissions at a different rate compared to the current primary assigned aircraft. For calculation purposes base stationary emissions were assumed to remain the same. This is a conservative approach because it is likely that any new equipment installed at the base would be more efficient and have lower emissions than the equipment currently present. It is also possible that the installation or modification of any air emission sources, such as boilers and heaters, emergency generators, paint booths, degreasers, etc., may trigger permitting requirements with the State of Hawaii Department of Health under Hawaii Regulations.

Factors used to estimate project aircraft emissions were obtained from the *Air Emissions Inventory Guidance Document for Mobile Sources at Air Force Installations* (AFIERA 2002) and the Air Quality Branch of the Air Force Institute for Operational Health. Table 4.4-2 summarizes the estimated changes in aircraft emissions for the Proposed Action. These data show that the Proposed Action would increase air emissions of VOCs, CO, PM_{10}, and $PM_{2.5}$, while decreasing emissions of NO_x and SO_x. Of the four criteria pollutants that would experience increased emissions, none would exceed any emission significance level.

Hazardous air pollutant emissions are of concern because of their potential to impact public health. Hazardous air pollutants generally are minor subsets of VOC and PM_{10} emissions. Table 4.4-2 shows that the implementation of the Proposed Action would increase annual emissions of VOC by 6.69 tons and PM_{10} by 7.20 tons. Jet fuel combustion produces the overwhelming majority of VOC and PM_{10} emissions from the Proposed Action. Formaldehyde comprises the largest hazardous air pollutant portion of these VOC emissions, or about 17 percent of the total VOCs, and arsenic comprises the largest hazardous air pollutant portion of PM_{10}, or about 0.5 percent of the total PM_{10} (California Air Resources Board 2006). Hence, the peak annual emissions would amount to approximately 1.14 tons of formaldehyde, and 0.04 tons of arsenic. These emission increases would not exceed 10 tons per year of any hazardous air pollutant or 25 TPY of combined hazardous air pollutants. As a result, the Proposed Action would produce less then significant air quality impacts in Honolulu County and the State of Hawaii (AQCR 60).

Table 4.4-2. Annual Change in Operational Emissions As Result of Proposed Action

	Annual Change (In Tons)[1]					
Source	*VOC*	*CO*	*NO_x*	*SO_x*	*PM_{10}*	*$PM_{2.5}$*
Aircraft	6.34	84.41	1.87	(0.04)	5.00	4.96
Aircraft Engine Testing	0.34	8.94	(2.85)	(1.17)	2.20	2.18
Total	6.69	93.35	(0.97)	(1.21)	7.20	7.13
NEPA Significance Threshold	100	100	100	100	100	100

Note: 1. Parentheses represent a reduction in emissions from current levels.

4.4.2 *No Action Alternative*

The No Action Alternative at Hickam AFB would not generate any new construction emissions and would not change operational emissions from current baseline levels presented in Section 3.4. As a result, the No Action Alternative would produce less then significant air quality impacts.

4.5 Natural Resources - Physical Resources

4.5.1 *Proposed Action*

Base. The F-22A is the first major Air Force weapon system to incorporate hazardous materials, pollution prevention and environment, safety, and health considerations from design throughout the weapon system lifecycle.

Water Resources. Construction of the F-22A facilities under the Proposed Action would affect approximately 15 acres of land previously disturbed through base development and mission operations. All facilities would be designed and constructed to meet seismic design standards for the base. Because more than 1 acre would be disturbed by construction, a construction NPDES storm water permit would be obtained from the State of Hawaii Department of Health through their industrial permit program. Per NPDES guidelines, the permit application would be submitted at least 180 days prior to construction. Under the permit, the base would submit a site-specific SWPCP (also referred to as Storm Water Pollution Prevention Plan [SWPPP]) for new discharges that describes BMPs to be implemented to eliminate or reduce sediment and non-storm water discharges. With proper design and implementation of the SWPPP, impacts from erosion and off-site sedimentation would be negligible. To maintain compliance with current NPDES permits, new construction would contain wastewater discharges to the Fort Kamehameha WWTP and prevent site-generated pollutants from entering storm water pathways to coastal environments or groundwater. For construction areas that would remain cleared for more than 30 days, temporary soil stabilization to control erosion and compaction would be implemented with appropriate vegetation. Permanent soil stabilization and landscaping would be applied as soon as practical. Base Civil Engineering would assure compliance and oversee possible review of permit as final designs are prepared.

Construction of the facilities that would support the beddown of the F-22A would result in some areas subject to storm water runoff from the construction for a five-year time span (FY 2007 to FY 2011). Runoff from these construction areas could contain contaminants that would degrade the quality of receiving waters. Once the facilities are constructed, storm water from the new impervious surfaces would be directed to open areas by sheet flow or swales for percolation into the shallow aquifer.

Hazardous Materials. Existing procedures for the centralized management of the procurement, handling, storage, and issuing of hazardous materials through the HAZMART are adequate to handle the changes anticipated with the replacement of F-15 aircraft with F-22A aircraft. Construction of the F-22A facilities may require the use of hazardous materials by contractor personnel. Project contractors would comply with federal, state, and local environmental laws and would employ affirmative procurement practices when economically and technically feasible.

All hazardous materials and construction debris generated by the proposed project would be handled, stored, and disposed of in accordance with federal, state, and local regulations and laws. Permits for handling and disposal of hazardous material would be coordinated by the contractor with the base hazardous waste program manager. The use of hazardous materials would not cause adverse impacts.

In the event of fuel spillage during renovation or construction, the contractor would be responsible for its containment, clean up, and related disposal costs. The contractor would have sufficient spill supplies readily available on the pumping vehicle and/or at the site to contain any spillage. In the event of a contractor related release, the contractor would immediately notify the 15 CES office and take appropriate actions to correct its cause and prevent future occurrences. In the event of uncovering fuel or other hazardous material during construction activities, the contractor would notify the 15 CES and take appropriate actions as described in state permits, the Dewatering Plan, and BMPs.

Hazardous Waste. Hickam AFB would continue to generate hazardous wastes during various operations and maintenance activities. Hazardous waste disposal procedures, including off base disposal procedures, are adequate to handle changes in quantity and would remain the same. The base's plans and regulations would be updated to reflect any changes of hazardous waste generators and waste accumulation point monitors. The number of hazardous waste accumulation sites would be modified to handle the change in waste generation and there would be no adverse impacts. In the event that any hazardous wastes are generated as a result of F-22A maintenance activities that present any unique hazards over those generated by the F-15 aircraft, Hickam AFB would implement appropriate hazardous waste control procedures to minimize potential risks to personnel and the environment.

The low observability coatings of the F-22A require special treatment. Low observability composite repair facilities are proposed for construction as part of the F-22A facilities at Hickam AFB. These facilities provide engineering and environmental controls whereby any hazardous materials associated with the composite materials used by the F-22A can be isolated from the air and water environments for safe disposition. The replacement of F-15 aircraft with F-22A aircraft to the F-22A should have no new environmental effects on physical resources at Hickam AFB.

Asbestos. Structures slated for demolition or renovation associated with the transition to the F-22A weapon system may have the potential for having ACM. Materials containing ACM include floor tile, adhesive, window caulk, and roofing material. AFI 32-1052, *Facilities Asbestos Management*, requires that when safety and budgetary considerations permit, complete removal of asbestos-containing material would be included in military construction program facility projects. Asbestos surveys (taking samples and obtaining analysis by a state-certified laboratory) would be performed prior to demolition to locate all ACM. Where asbestos is found, the demolition contractor would perform any and all asbestos work in accordance with applicable laws. Contractor personnel would be appropriately trained and certified, as necessary. Also, the contractor would submit an Asbestos Work/Disposal Plan for the demolition. Transport and disposal documentation records, including signed manifests, would also be required. With these management requirements in effect, there would be no anticipated adverse impacts resulting from asbestos contamination from demolition of buildings. ACM would not be employed for any new constructed units; therefore, there would be an overall beneficial result upon the removal of potential exposure to ACM.

Lead-Based Paint. Materials that may be potentially disturbed as part of the transition to the F-22A weapon system containing LBP include interior baseboards, windowsills, metal doorframes, window frames, exterior wood trims, and soffits. LBP-containing materials do not have to be treated as hazardous waste as long as these materials are not removed from a structure prior to demolition. Prior to any renovation and demolition activities, the Environmental Flight would review all construction project programming documents, designs, and contracts. Projects requiring alteration or demolition of an existing housing structure would require LBP surveys. Project designs would stipulate the appropriate abatement and disposal requirements for LBP. With these management requirements met, there would be no anticipated adverse impacts as a result of implementation of the Proposed Action from LBP.

LBP would not be employed for any new constructed units; therefore, there would be an overall beneficial impact to base personnel upon the removal of potential exposure to LBP.

IRP. Construction supporting the F-22A aircraft may occur near nine IRP sites located within the proposed construction area. The Air Force will ensure that coordination with the Restoration (15 CES/CEVR) Office would be conducted before any construction work is initiated. The Air Force will ensure that construction activities are coordinated with ongoing remediation or investigation activities at any CERCLA or Superfund Amendments and

Reauthorization Act sites. Any soil suspected of contamination, as discovered during the construction process, would be tested and disposed of in accordance with appropriate state and federal regulations. The environmental consequences for this resource are not anticipated to be significant.

Solid Waste Management. Demolition of the facilities would generate solid wastes consisting of concrete, brick, wood, structural steel, glass, and miscellaneous metal building components. These materials would be generated during a 5-year period from FY 2008 through FY 2014. Demolition contractors would be directed to mulch or recycle materials to the maximum extent possible, thereby reducing the amount of demolition debris disposed in landfills. Materials not suitable for recycling would be taken to a landfill permitted to handle construction debris wastes. Construction of new facilities would also generate debris, and based on studies conducted by USEPA (USEPA 1998), construction during the FY 2009 through FY 2012 timeframe would average 0.7 tons per day. Disposal of these wastes at the landfill would increase the daily flow by less than 1 percent and would not have a significant impact to the operating life of the landfill.

Airspace. The replacement of HIANG's current squadron of F-15 aircraft with an F-22A squadron would not substantially change airspace use or training operations above marine physical resources. During training, F-22A aircraft will spend more time at higher altitudes than the current F-15 aircraft. The F-22A would train with defensive countermeasures in existing airspace comparable to current F-15 training. Training chaff and flares would be used in accordance with approved operational procedures outlined in Section 2.3.2. Training airspace is located well offshore.

Under the Proposed Action chaff and flare use would decrease by 18 and 12 percent, respectively. As described in Appendix A, chaff consists of fine segments (thinner than a human hair) of aluminum-coated silica cut to lengths of approximately 10 to 50 or more centimeters to reflect radar signals from threats to aircraft. Assuming 95 grams of chaff fiber material is released each time a cartridge is successfully employed, approximately 12 grams of chaff would be expected to be widely dispersed per year for each square mile of open ocean area under training airspace. Upon initial contact with sea surfaces chaff would be expected to be briefly supported by surface tension. Wave action would quickly cause vitreous chaff fibers to enter the water column where their negative buoyancy would carry them to the seafloor. No studies characterize transit time of chaff fibers through the deep sea water column. Chaff is comprised primarily of silica and aluminum, two of the earth's most common elements. In most environments, chaff rapidly breaks up to become indistinguishable from native substrates. Chaff use would be difficult to detect in the environment and would not produce a significant effect upon ocean waters under the airspace.

Plastic, nylon, and Mylar pieces that fall when chaff is deployed are inert. These pieces are similar to the plastic pieces that come from current chaff use. The Mylar wrapping is similar to the aluminum-coated Mylar that falls when flares are deployed. These materials are inert and are not expected to be concentrated in any way under any specific airspace. Plastic debris of any type is a serious and increasingly high profile issue in marine environments. The persistence and accumulation of waste plastic materials from a variety of sources is well-studied in many ocean basins, including the North Pacific. Under the Proposed Action approximately 20,900 plastic end caps, 20,900 piston assemblies, and 62,700 2-inch by 4-inch Mylar wrappers would enter the environment each year. Although the total number of chaff bundles deployed would be reduced with F-22A training as compared with F-15 training, there would be more pieces of plastic materials because the RR-180A/AL includes the Mylar wrappers. This volume of plastics is a statistically insignificant amount of plastic, compared to other sources of plastic waste in the North Pacific. Quantifiable, predictable, and avoidable sources of plastic debris should be noted. Any inert plastics have the potential to enter the plankton food chain and interfere with normal food web function and therefore water chemistry.

Flare ash consists of magnesium oxide and magnesium nitride produced as combustion products of burning magnesium in air. This material poses no risk to marine water resources under the Proposed Action. Flare debris consist of 1-inch by 1-inch plastic or nylon parts, aluminum-coated Mylar wrapping materials, and a medium hailstone-sized plastic safe and initiation device. These pieces are inert and do not pose a direct risk to physical resources under training airspace. Effects of the accumulation of flare-related plastic debris would decrease from baseline and be similar to that described above for chaff debris.

4.5.2 No Action Alternative

Under the No Action Alternative, F-15 aircraft would continue their mission with the HIANG at Hickam AFB and an F-22A squadron would not replace the F-15 squadron. No new project-related construction would occur; no renovations and upgrades to facilities to support F-22A aircraft would occur. Impacts to physical resources on base would continue as under current conditions. F-15 chaff and flare use under training airspace would continue to be greater than that proposed for F-22A training. Debris related to defensive counter measure use would continue to be produced at current approved levels.

4.6 Natural Resources - Biological Resources

Potential impacts to biological resources, including plants, wildlife and habitat is based on the following:

- Importance of the resource (i.e., legal, commercial, recreational, ecological, or scientific) of the resource;
- Proportion of the resource that would be affected relative to its occurrence in the region;
- Sensitivity of the resource to the Proposed Action's activities; and
- Duration of ecological ramifications.

Impacts to resources are significant if habitats of high concern are adversely affected over relatively large areas; if disturbances to small, essential habitats would lead to landscape-levels effects on the ecology; or if disturbances impact the abundance or distribution of federally or state-listed species. Permanent habitat loss and temporary disturbance due to construction are specific issues and concerns for biological resources. Habitat degradation caused by post-construction promotion of exotic weeds is also a consideration.

This section discusses environmental consequences of construction and operations associated with the Proposed Action and No Action Alternative at Hickam AFB and training airspace.

4.6.1 Proposed Action

On base under the Proposed Action, renovation and new construction would affect 15 acres of previously disturbed area. BMPs during construction activities would abate dust, protect sensitive wetlands, and prevent silt from entering stormwater systems and subsequently silting in sensitive coral reef habitats. NPDES guidelines require that vegetation cover not be removed more than 20 days prior to construction. Permanent revegetation, including landscaping, must be implemented as soon as possible after final grading is complete.

No federally listed species are likely to be directly impacted by the Proposed Action at Hickam AFB. All identified federally listed species either have little likelihood of occurrence, or, if present, would be more likely to occur as transients in open spaces peripheral to the project site and open water sources including wetlands. There is no critical habitat or essential resources for listed species present at Hickam AFB. Any disturbance effects associated with construction would be minor or temporary and have no impact on species distribution or abundance.

Noise and visual characteristics associated with F-22A airfield operations would be somewhat greater than the existing F-15 airfield operations. Species on or in proximity of the base are assumed to have adapted behavior to an airport environment. The exchange of F-22A for F-15 aircraft would not present a significant difference to wildlife species. Impacts to biological resources from construction and operations of the Proposed Action at Hickam AFB would be less than significant.

Training operations would fall well within guidelines for aircraft activity near federally protected marine species. Training altitudes would increase under the Proposed Action (from an existing 8 percent above 30,000 feet MSL to a proposed 30 percent above 30,000 feet MSL). Supersonic activity would increase, as would the number of sonic booms. Appendix E describes that the air-to-water transmission of impulse noise would not be expected to reach noise levels that could qualify as harassment or other impacts upon marine mammal species. Training chaff and flare use would decrease from baseline. Appendix A describes the characteristics of chaff. Chaff use would decrease by 18 percent and flare use would decrease by 12 percent. Opportunities for sensitive wildlife receptors, such as leatherback turtles, to encounter chaff or flare debris would decrease slightly except in the case of Mylar pieces from F-22A chaff. The average annual concentration of chaff Mylar pieces and other pieces would be approximately 0.6 to 13 pieces per square mile of ocean per year depending upon the airspace. This level of Mylar and plastic materials would not be expected to produce a significant marine impact. Special status species and consequences are summarized in Table 4.6-1. Overall, impacts to biological resources from training operations under project-related airspace would be less than significant.

Training in the offshore Warning Areas and ATCAAs would also increase the number of sonic booms reaching the surface. The F-22A flies at higher altitudes and spends more time at supersonic speeds than the F-15. This would result in an increase in sonic booms. W-189 has the greatest level of training activity for the F-15 and projected for the F-22A. Any given surface area under W-189 currently experiences an estimated six to seven sonic booms monthly and would be expected to experience an estimated 21 sonic booms monthly with F-22A training. The sonic boom overpressures are not of noise levels that would be expected to impact marine mammals (see Appendix E).

4.6.2 No Action Alternative

Under the No Action Alternative no F-22A operational squadron would be established with the HIANG at Hickam AFB. Maintenance and operations of the current F-15 squadron would continue. The No Action Alternative would be the same as baseline conditions. No general increase in training altitudes would occur. Training chaff and flare use would continue at current levels.

Table 4.6-1. Summary of Consequences to Special Status Species Occurring in Offshore Marine Habitats Beneath Military Training Airspace

Common name	*Scientific name*	*Federal Status*	*Notes on ecology, feeding and potential for effects*
Humpback whale	*Megaptera novaeangliae*	Endangered	Migrate beneath portions of airspace in transit from Hawaiian calving areas and Alaskan feeding areas. Do not feed under airspace. Highly unlikely to be affected by changes associated with the Proposed Action.
Loggerhead turtle	*Caretta caretta*	Threatened	Trans-Pacific migrator. Occurs in Hawaiian waters (north of 22° latitude) during migrations between Japan and Mexico. Adults feed on benthic invertebrates. No effect anticipated under the Proposed Action.
Green turtle	*Chelonia mydas*	Threatened	Juveniles and adults occupy near-shore habitats in Hawaiian waters. Sub-adults venture into offshore environments to feed on planktonic invertebrates. No effect anticipated under the Proposed Action.
Leatherback turtle	*Dermochelys coriacea*	Endangered	Almost exclusively pelagic in Hawaiian waters. Adults specialized jelly (jellyfish) specialists. Known to incidentally consume plastic debris in open ocean environments. Defensive countermeasure use under the Proposed Action represents insignificant contribution to oceanic plastic waste pool. No effect anticipated under the Proposed Action.
Hawksbill turtle	*Eretmochelys imbricata*	Endangered	Rare visitor to coastal Hawaiian waters; nests on two beaches. Juveniles find refuge in offshore macroalgae paddies and weed lines. Here they are known to consume plastic debris. Adults are sponge specialists. Project activities do not contribute significantly to existing plastic debris pool. No effect anticipated under the Proposed Action.
Olive ridley turtle	*Lepidochelys olivacea*	Threatened	Adults from western and Eastern Pacific may converge in Hawaiian waters. Nesting in Hawaii extremely rare. Adults feed on jellies (jellyfish) and other invertebrates. No effect anticipated under the Proposed Action.

4.7 Cultural Resources

Under federal law, impacts to cultural resources may be considered adverse if the resources are eligible for listing, or listed in, the NRHP, or are important to Native Hawaiian groups. An NRHP-listed or eligible resource is a historic property. An action results in impacts to a historic property when it alters the resource's characteristics, including relevant features of its environment or use, in such a way that it no longer qualifies for listing in the NRHP. Impacts to traditional resources are identified in consultation with affected Native Hawaiian groups.

Analysis of potential impacts to cultural resources considers both direct and indirect impacts. Direct impacts may occur by physically altering, damaging, or destroying all or part of a resource; altering characteristics of the surrounding environment that contribute to the resource's significance; introducing visual or audible elements that are out of character with the property or alter its setting; or neglecting the resource to the extent that it deteriorates or is destroyed. Direct impacts can be assessed by identifying the types and locations of proposed activity and determining the exact location of cultural resources that could be affected. Indirect impacts generally result from the effects of project-induced population increases and the need to develop new housing areas, utility services, and other support functions to accommodate population growth. These activities and the subsequent use of the facilities can impact cultural resources.

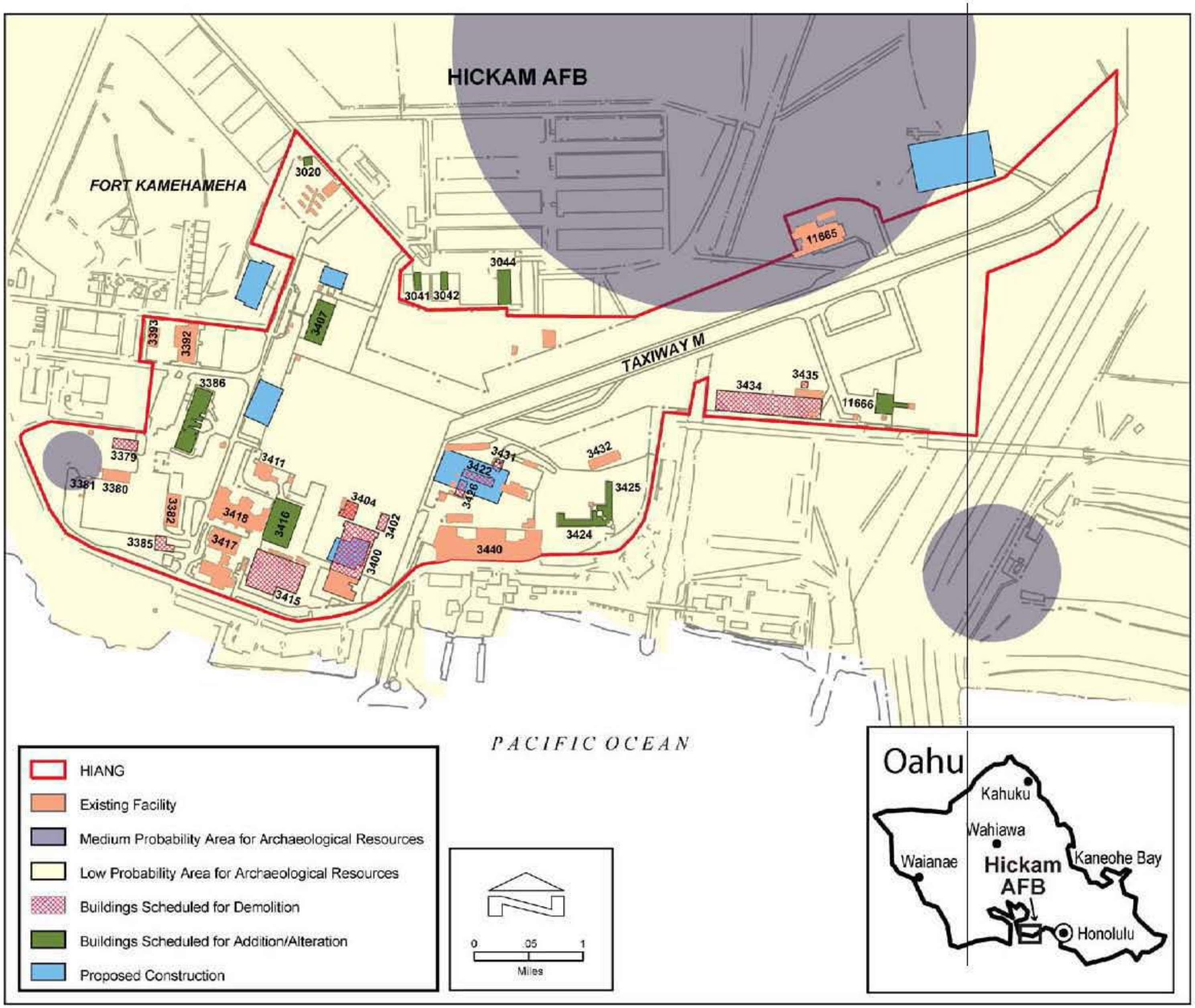
4.7.1 *Proposed Action*

Archaeological Resources

The close proximity of the proposed actions (Figures 3.7-1 and 4.7-1-additional changes included in SHPD packaged) to Fort Kamehameha indicates a potential for buried historic military resources even though the BHPO identified most of the ROI as having low archaeological sensitivity (Figure 4.7-1). Portions of the ROI also contain areas of medium archaeological sensitivity, as identified by the BHPO (Hickam AFB n.d.). These areas of archaeological sensitivity would be monitored by a qualified professional archaeologist during ground-disturbing activities, as specified by Section 7.1.1.1 of the Hickam AFB CRMP (Hickam AFB n.d.) and as further specified in the SHPD Section 106 letter (Appendix C). If archaeological resources were encountered, work would stop at that location until the find was evaluated by a qualified professional archaeologist, in accordance with the emergency discovery procedures outlined in Section 7.1.5 of the CRMP (Hickam AFB n.d.).

The location of the proposed expansion parcel for the Homeland Defense Fighter Alert Facility (HDFAF) may extend into an area of historic fishpond complexes, according to the base archaeological sites map (Hickam AFB n.d.). As specified by Section 7.1.1.1 of the CRMP, areas of high archaeological probability, as identified by the BHPO, require archaeological testing prior to any construction activities if the project involves any ground disturbing activities in this area (Hickam AFB n.d.). Construction of the HDFAF has been the subject of a prior Environmental Assessment (Air Force 2006d), in which a testing program has already been specified. With the implementation of the aforementioned mitigation procedures, impacts to archaeological resources would be expected to be negligible.

FIGURE 4.7-1. ARCHAEOLOGICAL PROBABILITY MAP FOR HICKAM AFB



Architectural Resources

Of the 21 facilities proposed for demolition or alteration (Table 4.7-1), none are considered eligible for the NRHP under any criteria (see Appendix C).

NRHP-listed Battery Jackson and Battery Selfridge of the Fort Kamehameha Historic District will not be directly affected by the Proposed Action. In addition, their setting has been compromised such that alterations to existing adjacent facilities and the construction of new facilities will have no impact on their NRHP status (see Appendix C).

The Hickam AFB CRMP identifies several HIANG-proposed projects with high or moderate potential to affect cultural resources. A medium potential area is associated with Building 3379, which has the potential for archaeological remains of Queen Emma's house in the vicinity (Figure 4.7-1) (Hickam AFB n.d.). Because of the archaeological sensitivity of this location, cultural resources monitoring by a professional archaeologist during earthmoving actions would take place under the direction of the BHPO. In the event of discovery of human remains or artifacts during any activity, work would stop at that location and the discovery would be reported to the Security Police and the BHPO. HIANG has contacted the Office of Hawaiian Affairs regarding the Proposed Action. If a human burial were to be encountered during project construction, it would be managed in compliance with the Memorandum of Agreement (Burial Treatment Plan) among the Air Force, the Office of the Hawaiian Affairs, Hui Malama I Na Kupuna `O Hawai`i Nei, and the Oahu Island Burial Council. Therefore, impacts to traditional resources would be expected to be negligible.

In compliance with Section 106 of the NHPA, Hickam AFB has completed consultation with SHPD regarding the Proposed Action. SHPD has concurred that no historic properties would be affected by the Proposed Action, and that archaeological monitoring during ground disturbing activities will be sufficient to mitigate for any unanticipated discovery of subsurface cultural resources (Appendix C). Further compliance with Section 106 of the NHPA, including Native Hawaiian consultation and the preparation of an archaeological monitoring plan, would be completed prior to implementation of the Proposed Action.

4.7.2 No Action Alternative

Impacts to cultural resources are not expected under the No Action Alternative. Existing facilities would be maintained, new facilities would not be built, and new real estate would not be acquired. Cultural resources would continue to be managed in compliance with federal law and Air Force regulations.

Table 4.7-1. Structures Proposed for Demolition or Alteration

Building Number	*Proposed Action*	*Facility Category Name*	*Construction Year*	*NRHP Eligibility*
3020	Alteration	Petrol Operations	1994	Not Eligible
3041	Alteration	Munitions Storage Igloo	1991	Not Eligible
3042	Alteration	Munitions Storage Igloo	1991	Not Eligible
3044	Alteration	Munitions Maintenance Shop	1991	Not Eligible
3379	Demolition	Warehouse Supply	1986	Not Eligible
3385	Demolition	Communications Facility	1988	Not Eligible
3386	Alteration	Weapons and Release Systems Shop	1991	Not Eligible
3400	Demolition (Partial)	Hangar and Squadron Operations	1961	Not Eligible
3402	Demolition	Aircraft Maintenance Shop	1962	Not Eligible
3404	Demolition	Squadron Operations	1962	Not Eligible
3407	Alteration	Fuel Cell Corrosion Control	1997	Not Eligible
3415	Demolition	Warehouse Supply	1963	Not Eligible
3416	Alteration	Jet Engine Maintenance Shop	1976	Not Eligible
3422	Demolition	Aircraft Maintenance Shop	1964	Not Eligible
3424	Alteration	Aerospace Ground Equipment Maintenance Shop/Vehicle Maintenance Shop	1995	Not Eligible
3425	Alteration	Battery Room	1995	Not Eligible
3426	Demolition	Aircraft Maintenance Shop	1983	Not Eligible
3431	Demolition	General Purpose Shop (Aircraft)	1967	Not Eligible
3434	Demolition	Aircraft Maintenance Shop	1989	Not Eligible
3435	Demolition	Aircraft Maintenance Shop	1989	Not Eligible
11666	Alteration	Hush House	1989	Not Eligible

4.8 Land Use and Transportation

4.8.1 *Proposed Action*

The proposed facility and infrastructure construction and renovation in support of the F-22A beddown is consistent with the current Hickam AFB General Plan (Air Force 2006b), and would not require a change in the designated existing or future land use in the HIANG area. The new facilities would be constructed on previously disturbed ground and no new construction would occur outside of the HIANG facility. The HIANG facilities proposed for F-22A beddown are not within the CZs or APZs. The 154 WG and 15 FW are currently in the process of expanding their leased area. Appropriate real estate and environmental documents will be prepared.

Due to the location of the HIANG area, along the coastline and in the Coastal Zone Management Area, activities that occur on the installation that may potentially affect the coastal zone are required to undergo a consistency determination process. Should the Proposed Action be selected, the HIANG will work with the Hawaii Coastal Zone Management Program, Office of Planning prior to implementation of the Proposed Action.

If the Proposed Action is implemented, the total off-base acreage exposed to levels of noise between L_{dn} 65 and 70 dB would not substantially change from existing conditions. This is primarily due to the adoption of a modified approach for F-22A landings that is being coordinated between the FAA and the HIANG (Figure 4.2-1). Most of the areas that would be exposed to a higher noise level are military properties, over water, or within areas already designated for industrial land use (e.g., Honolulu International Airport or Honolulu harbor's industrial port).

The residential areas potentially affected by noise levels between L_{dn} 65 and 70 dB are primarily located to the west of Hickam AFB across Mamala Bay, and north of Interstate Route H-1, west of Puuloa Road. Both of these areas are Navy base housing facilities.

Keehi Lagoon Beach Park and Sand Island State Recreation Area are currently underneath the L_{dn} 70 to 75 dB noise contour. People visiting the parks would continue to experience noise levels that they may find annoying and that could potentially detract from the overall outdoor recreational experience. However, it is important to note that this is not a change from the existing condition, and the parks were established in close proximity to military installations, industrial ports, and an international airport. Live-aboard boats within the Keehi Boat Harbor are currently subject to noise levels of L_{dn} 75 to 80 (Mestre Grove Associates 2004). The replacement of F-15 aircraft with F-22A aircraft would not be expected to change these noise levels.

Based on numerous sociological surveys and recommendations of federal interagency councils, the most common benchmark for assessing environmental noise impacts to people is a noise level of L_{dn} 65 dB or higher. The noise level threshold of L_{dn} 65 is often used to determine residential land use compatibility and the risk of human annoyance. In general, when exposed to less than L_{dn} 65, land uses are unrestricted. As noise levels increase above this level, some land uses become incompatible.

The people living in the U.S. Navy and Hickam base housing would be expected to recognize an increase in noise. Most of these neighborhoods have existed underneath flight patterns dominated by commercial aircraft for Honolulu International Airport and Hickam AFB for many years. An estimated 100 homes in residential developments in the Ewa area would be subject to noise in excess L_{dn} 65 dB. Residents of these homes may become annoyed that their home is now within an area subject to more noise. The L_{dn} 65 dB noise contour is the noise level above which the potential for significant impacts could occur.

Hickam AFB implements a noise abatement program that precludes flight operations between the hours of 10 p.m. and 7 a.m. except for national emergencies. Aircraft operations between 10:00 p.m. and 7:00 a.m. are given a 10 dB noise penalty in noise models. The noise abatement program reduces the exposure of areas to 65 dB contours to fewer than it would be without the noise abatement program.

Overall, negative impacts to the transportation system on Hickam AFB would not occur as a result of the F-22A beddown at the HIANG facility. Under this alternative, the total number of on-base personnel associated with the HIANG would remain essentially unchanged from current levels. On-base traffic conditions are not expected to change with the replacement of F-15 aircraft by F-22A aircraft.

AT/FP guidelines present a range of considerations designed to protect government assets from terrorist activities. These guidelines identify stand-off distances for explosive weight II risks. Depending on the location for facilities to support the Hangar/Squad Operation or other facilities, transportation corridors that pass close to the southern side of the HIANG compound may require a waiver from AT/FP guidelines.

Recreational facilities and beach recreation adjacent to the HIANG area would not have long-term effects from replacement of the F-15s with F-22As. Some short-term disruption could occur as a result of construction vehicle traffic or parking of construction personnel vehicles in recreational parking areas. This would primarily occur during weekday working hours and should not affect the more intensely used beaches during weekends. Noise levels from F-22A landing would not be expected to be detectable to recreational users.

Safety QD arcs associated with the F-22A are larger than current safety arcs for the F-15. The QD arc is calculated based on the spread of materials from an accidental explosion. The F-22A carries the same munitions internally as the F-15 does externally. An internal explosion is calculated to spread more materials, including parts of the aircraft, over a larger area. The F-22A QD arc (758 foot radius) is larger than the F-15 QD arc (400 foot radius). These arcs would extend over temporary-use on-base recreation locations and to some on-base incompatible land use. These areas would require an updated Explosive Site Plan in accordance with AFI 91-201, Chapter 4 that will account for this extension and its impact to surrounding work areas.

Recreational boating under the Warning Areas or ATCAAs would not be likely to see the F-22As flying at normal training altitudes. The only detectable training activity could be an occasional sonic boom. The speed and altitude of most F-22A training would have the effect of an increased number of sonic booms with either the impulse signature of thunder or the double crack of a typical sonic boom.

4.8.2 No Action Alternative

Under the No Action Alternative, F-22A aircraft would not beddown at Hickam AFB and the current F-15 squadron would continue current operations. No changes would be expected in land use. The only effect on the transportation system if the No Action Alternative is selected would be the loss of benefit that would have resulted from fewer vehicles on the roads. F-15 supersonic activity would continue in training airspaces.

4.9 Socioeconomics

Potential socioeconomic consequences were assessed in terms of effects of the Proposed Action on the local economy from changes in project personnel or expenditure levels. Economic multipliers, migration ratios, and other factors are used to determine the total economic effect of project-related changes on regional socioeconomic attributes. Demographic and economic characteristics at Hickam AFB, and the City and County of Honolulu were analyzed, as presented in Section 3.9.

Potential socioeconomic consequences are evaluated for factors associated with the replacement of F-15 aircraft with F-22A aircraft at Hickam AFB. These factors include new construction, facility modifications, and level of support. Construction activity associated with facility modifications on base generates temporary economic benefits to the region in terms of employment and income. Personnel level of support associated with the replacement would not be expected to have any economic effects in the region.

4.9.1 *Proposed Action*

4.9.1.1 *Construction-Related Consequences*

Replacement of the F-15 with the F-22A would require upgraded or additional facilities at the HIANG compound on Hickam AFB. There would be approximately 20 renovation, construction, or infrastructure improvement projects implemented over the period from FY 2008 to FY 2012 with an estimated cost of $146.4 million in FY 2007 dollars. These construction activities would generate a number of jobs during the construction period, and contribute to local earnings and induced spending. Contracting would be performed using ANG procedures.

Potential direct impacts associated with the proposed construction projects would include 700 construction jobs over the entire construction period and $37 million in direct earnings. The total socioeconomic impact of the proposed construction would amount to an estimated $215 million in economic activity, generating 1,450 total jobs and total earnings of $57 million (U.S. Bureau of Economic Analysis 2004). These effects would be for the duration of the construction period. Honolulu is a large metropolitan area with a city population of 362,252 and a county population of 873,177. Approximately 20,000 or 5 percent of the county's employees were in the construction trades in 2005. During 2006, construction jobs increased 7.6 percent. This growth is not expected to continue. The anticipated flattening in growth as a result of a slowing in the Mainland and Japanese economies is expected to result in increased availability of construction workers during the F-22A facility construction years. No permanent or long-lasting socioeconomic impacts would be associated with construction to meet F-22A requirements.

4.9.1.2 *Operations-Related Consequences*

Beddown of the F-22A would require personnel to operate and maintain the aircraft and provide necessary support services. The HIANG includes personnel in varying duty status. That status can involve full or part-time assignments. The change in aircraft from the F-15 to the F-22A would involve some changing assignments. Such factors as retirements, extent of hours worked, and support for other activities could all be part of the changing assignments. There is no projected change in total personnel.

The HIANG part-time and full-time employment would not be expected to change the number of employees. Some HIANG personnel would have a changed commitment to Guard duties, and some retiring personnel may not be replaced. The City and County of Honolulu would not be expected to not have a noticeable change in population either from direct or secondary expenditures.

4.9.2 No Action Alternative

Under the No Action Alternative, the proposed exchange of F-15 aircraft with F-22A aircraft would not occur at Hickam AFB at this time. The proposed facility modifications and personnel assignment changes would not take place. Therefore, no socioeconomic effects associated with the F-22A would be anticipated.

4.10 Environmental Justice

Environmental justice analysis applies to potential disproportionate effects on minority or low-income populations. Environmental justice issues could occur if an adverse environmental consequence to the human population fell disproportionately upon minority or low-income populations.

Minority or low-income populations within the vicinity of Hickam AFB do not represent a disproportionate segment of the population. No residential land or populations of concern are located under the F-22A training airspace. Facility modifications and personnel changes associated with the aircraft exchange are not expected to create significant adverse environmental or health effects to the human population. There are no special risks to children associated with the aircraft exchange, construction, or aircraft operations.

4.10.1 Proposed Action

There would be no change in long-term employment and a short-term increase in construction-related employment. This is not expected to disproportionately affect disadvantaged populations. No residential land or populations of concern are located under the F-22A training airspace. There are no anticipated special health or safety risks to children associated with the Proposed Action.

4.10.2 No Action Alternative

Under the No Action Alternative, no change in flight activity, noise contours, facilities, or personnel are anticipated. No impacts to populations of concern would occur.

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5.0 CUMULATIVE CONSEQUENCES

5.1 Cumulative Effects Analysis

The CEQ regulations stipulate that the cumulative effects analysis in an EA considers the potential environmental consequences resulting from "the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR 1508.7). Chapter 3.0 discussed the baseline conditions at Hickam AFB and under the training airspace. Chapter 4.0 addressed the potential for environmental consequences at Hickam AFB and under the training airspace. Chapter 5.0 identifies and evaluates past, present, and reasonably foreseeable other projects, which could cumulatively affect environmental resources in conjunction with the proposed F-22A replacement action at Hickam AFB and use of training airspace.

Assessing cumulative effects begins with defining the scope of other actions and their potential interrelationship with the Proposed Action or alternatives (CEQ 1997). The scope must consider other projects that coincide with the location and timetable of the Proposed Action and other actions. Cumulative effects analyses evaluate the interactions of multiple actions. The first steps of the environmental impact analysis process helped identify other potential and planned actions. During early community outreach efforts, the public and agencies were asked to provide information about ongoing regional projects and the potential interaction of the F-22A beddown at Hickam AFB with such projects. These initial discussions defined the ROI, which in turn defined what actions should be considered cumulatively. The ROI for cumulative effects would have both spatial and temporal dimensions.

The CEQ (1997) identified and defined eight ways in which effects can accumulate: time crowding; time lag; space crowding; cross boundary; fragmentation; compounding effects; indirect effects; and triggers and thresholds. Furthermore, cumulative effects can arise from single or multiple actions, and through additive or interactive processes (CEQ 1997).

Actions not identified in Chapter 2.0 as part of the proposal, but that could be considered as actions connected in time or space (40 CFR 1508.25) (CEQ 1997) may include projects that affect areas on or near Hickam AFB, areas underlying the affected training airspace, as well as the airspace itself. This EA analysis addresses three questions to identify cumulative effects:

1. Does a relationship exist such that elements of the project alternatives might interact with elements of past, present, or reasonably foreseeable actions?
2. If one or more of the elements of the alternatives and another action could be expected to interact, would the alternative affect or be affected by impacts of the other action?
3. If such a relationship exists, does an assessment reveal any potentially significant impacts not identified when the alternative is considered alone?

An effort has been made to identify all actions that are being considered and that are in the planning phase at this time. To the extent that details regarding such actions exist and the actions have a potential to interact with the proposal, these actions are included in this cumulative analysis. This approach enables decisionmakers to have the most current information available so that they can evaluate the environmental consequences of the Proposed Action.

5.1.1 Past, Present, and Reasonably Foreseeable Actions

This EA applies a stepped approach to provide decisionmakers with not only the cumulative effects of the Proposed Action, but also the incremental contribution of past, present, and reasonably foreseeable actions.

5.1.1.1 Hickam AFB and Other Military Actions

Recent past and ongoing military action in the region were considered as part of the baseline or existing condition in the ROI. Each project (summarized in this section) was reviewed to consider the implication of each action and its synergy with the Proposed Action and beddown options. Of particular concern were potential overlap in affected area and project timing. Shared aircraft operations were also a consideration.

Hickam AFB is the headquarters of PACAF and is an active military installation that experiences continuous and rapid evolution of mission and training requirements. This process of change is consistent with the U.S. defense policy that the Air Force must be ready to respond to threats to American interests throughout the world. Any new construction must comply with land use controls.

The base, like other major military installations, also requires new construction, facility improvements, and infrastructure upgrades. Table 5.1-1 lists current and potential major Air Force construction projects anticipated to occur on the base. Table 5.1-2 lists current and anticipated future off base military and non-military projects that may overlap in the potentially affected area or project timing with the Proposed Action.

5.1.1.2 Non-Federal Actions

Non-federal actions include projects of the State of Hawaii, various cities within the ROI, and private projects. The City of Oahu is a large urban area with many on-going construction projects. Specific major actions within the vicinity of Hickam AFB are summarized in Table 5.1-2.

5.1.2 Cumulative Effects Analysis

The following analysis considers how the reasonably foreseeable projects identified in Tables 5.1-1 and 5.1-2 could cumulatively result in environmental consequences in conjunction with the proposed replacement of F-15 aircraft with F-22A aircraft.

Airspace Management and Air Traffic Control, Noise, and Safety

Hickam AFB is a dynamic military installation with continuing changes in aircraft and personnel. In addition, the base serves as a key support facility for transient aircraft. Honolulu International Airport is a major commercial hub for air traffic throughout the Pacific. Additional aircraft permanently stationed at Hickam AFB, including C-17 and KC-135R aircraft, would minimally increase military operations at Hickam AFB. As noted in the discussion of existing airfield management conditions, 95 percent of aircraft operations are commercial, and that ratio is expected to continue. Introduction of the additional military aircraft noted in Tables 5.1-1 and 5.1-2 would not be expected to have a substantial effect on noise contours which are dominated by commercial traffic. The existing base safety zones are adequate to meet cumulative needs. No significant consequences are anticipated to airspace management and air traffic control, noise, or safety as a result of the F-22A replacement in combination with other reasonably foreseeable actions.

Natural Resources and Air Quality

Construction activity at Hickam AFB and in the region would have a temporary effect on air quality as a result of construction emissions. The Honolulu area is in air quality conformity, and the cumulative consequences would not be expected to result in emission levels which could affect regional air quality. New facilities would be expected to have improved boilers and other equipment with the overall potential for a reduction in base level emissions. Biological resources associated with Hickam AFB are compatible with the ongoing military operations. No significant cumulative effects to threatened and endangered species or other biological species are anticipated. Parts of Hickam AFB are within the 100-year floodplain, and construction projects on the base would need to meet base level permitting requirements and be compatible with NAVAC HI requirements.

Cultural Resources

No cumulative consequences are anticipated for cultural resources. Construction on Hickam AFB has the potential to encounter Hawaiian traditional sites. HIANG has contacted the Office of Hawaiian Affairs regarding the Proposed Action. If a human burial were to be encountered during project construction, it would be managed in compliance with the Memorandum of Agreement (Burial Treatment Plan) among the Air Force, the Office of the Hawaiian Affairs, Hui Malama I Na Kupuna 'O Hawai'I Nei, and the Oahu Island Burial Council. Therefore, cumulative impacts to traditional resources would be expected to be negligible.

Land Use and Transportation

Hickam AFB projects would be consistent with the industrial nature of a military installation. Other projects in the Honolulu area, such as housing or runway repaving, would be consistent with land use requirements. Construction activities presented in Tables 5.1-1 and 5.1-2 could be expected to increase traffic congestion for short-term periods but would not be expected to have a cumulative impact upon traffic to and from Hickam AFB. No significant cumulative consequences are expected to occur to land use or transportation in conjunction with the HIANG F-22A aircraft replacement.

Socioeconomics and Environmental Justice

Several projects presented in Tables 5.1-1 and 5.1-2 could have construction time periods which overlap and could increase demand upon construction resources. Honolulu is a large urban center and contains a large pool of skilled construction labor and construction materials suppliers who would be expected to meet the demand. The long term effect of multiple construction projects could result in an expansion to the construction industry on Oahu. Expansion of industrial activities and the overall economic activity usually results in direct and secondary benefits to all parts of the regional economy, including minority and low income persons. No negative effects upon children would be anticipated. No negative cumulative socioeconomic or environmental justice effects are anticipated as a result of the replacement of F-22A aircraft in combination with other reasonably foreseeable projects.

Table 5.1-1. Past, Present, and Reasonably Foreseeable Military Projects at Hickam AFB (Page 1 of 2)

Scheduled Project	*Description*	*Date of Implementation*[1]	*Relevance to F-22A Replacement*
C-17 Beddown	Establish squadron of 8 C-17 aircraft: slight increase in airspace use, related construction projects (Air Force 2003).	FY 2004-FY 2008	Most construction completed before F-22A; normally train in different airspace
Hot Cargo Pad	Expansion of hot cargo pad area.	FY 2005	Provides capabilities to meet any Hickam requirement
Fort Kamehameha Wastewater Treatment Plant	Construction, improvements, outfall re-build.	FY 2005-FY 2006	Improves base and HIANG area wastewater treatment capabilities to meet existing needs
Intelligence Squadron Operating Facility	New construction.	FY 2006	Meets base needs; scheduled to be completed before F-22A construction
Atterbury Circle Upgrade	Upgrade Atterbury Circle (flagpole area) to provide a location for dedication ceremonies, monuments, murals, and historical displays (Air Force 2006e).	2006-2007	Scheduled to be completed before F-22A construction
Military Family Housing Privatization Phase I (phases 1-4) Phase II	Privatization of 1,356 homes; demolition of 816 homes; construction of 756 homes.	5/05-8/10	Overlap with F-22A construction
Fire Training Facility Construction	Construction of new aircraft fire training facility, includes 150-foot diameter burn pit, new roadways, retention pond, etc.	FY 2006-FY 2009	Improves base for training and capabilities
Joint Regional CATM Range	Support live weapons training and qualification needs for the active Air Force, HIANG, the Air Force Reserves, and other DOD organizations in Hawaii. Provide an adequate training facility critical to the base readiness and mission sustaining in the future.	FY 2006-FY 2009	Enhances training capabilities for Hickam-based personnel

Table 5.1-1. Past, Present, and Reasonably Foreseeable Military Projects at Hickam AFB (Page 2 of 2)

Scheduled Project	*Description*	*Date of Implementation*[1]	*Relevance to F-22A Replacement*
Homeland Defense Fighter Alert Hangar	New construction.	FY 2006-FY 2009	Meets F-15 Alert mission; would be used for F-22A Alert mission
F-15 Rinse Facility	New construction.	FY 2006	Scheduled to be completed before F-22A replacement
KC-135R PAI Expansion	Beddown of four additional KC-135 aircraft. Brings total number of these aircraft to 12. Some construction and building renovation involved.	FY 2010	Not in HIANG fighter area on Hickam; construction overlap with F-22A facilities
C-37A Beddown	Navy aircraft to support Commander Pacific Fleet's Executive Transport requirements. The C-37A would operate missions within the Pacific theater as well as local training missions. Additional personnel are anticipated (Air Force 2006g).	2006-2007	Scheduled to be completed before F-22A replacement

Note: 1. Date of implementation is listed in either calendar years or government fiscal years (FY).

TABLE 5.1-2. PAST, PRESENT, AND REASONABLY FORESEEABLE MILITARY AND NON-MILITARY PROJECTS (PAGE 1 OF 2)

Scheduled Project	*Description*	*Date of Implementation*[1]	*Relevance to F-22A Replacement*
ARMY			
Schofield Barracks Construction Projects	Barracks, Mission Support Training Facility, Live Fire Complex, etc.	On-going	Most scheduled for completion prior to F-22A construction; some construction overlap
25th Infantry Stryker Brigade	291 Stryker combat vehicles and support at Schofield Barracks, includes Shadow Tactical Unmanned Aerial Vehicles. Federal Register 69:157 54768-54769.	Associated projects to FY 2009	Located away from Hickam; no joint training
NAVY and MARINE CORPS			
Pearl Harbor Waterfront Development	Water front improvements	Funded FY 2004	Most scheduled for completion prior to F-22A construction; some construction overlap
Pacific Warfighting Center	New construction at Pearl Harbor Naval Station	FY 2006-Ongoing	Some construction overlap; located away from Hickam
Helicopter Training Facility	New construction at Pearl Harbor Naval Station	FY 2007 to FY 2009	Some construction overlap; located away from Hickam
Hawaii Range Complex	Navy agency lead on enhancement of range complex covering land and sea. Multi-service benefit.	FY 2009 and beyond	Airspace currently meets F-22A needs; enhancements could benefit all users
USS *Hawaii*	Virginia-class sub based at Pearl Harbor Naval Station	Operational FY 2009	Construction overlap in region

Note: 1. Date of implementation is listed in either calendar years or government fiscal years (FY).

Table 5.1-2. Past, Present, and Reasonably Foreseeable Military and Non-Military Projects (Page 2 of 2)

Scheduled Project	*Description*	*Date of Implementation*[1]	*Relevance to F-22A Replacement*
USS *Carl Vinson*	Nuclear carrier stationed at Pearl Harbor Naval Station.	Decision by 5/07	Construction overlap in region
P-8A Multi-Mission Maritime Aircraft	Introduction of P-8A Multi-Mission Maritime Aircraft to the Navy Fleet. Proposed action includes transition from existing P-3C aircraft to P-8A Multi-Mission Maritime Aircraft. Hickam AFB has been identified as one of several potential receiving sites. Notice of Intent to prepare an EIS was published in the *Federal Register* in December 2006.	2011-2019	Some construction overlap; does not normally operate in same airspace as F-22A
Non-Military			
Honolulu Airport	12-year program of upgrades. Includes construction of stormwater system, gates, ramps, public parking, etc.	Ongoing	Construction overlap in region
Regional Construction Projects	Several residential development projects could increase population numbers in areas under the approach path of Honolulu International Airport.	Proposed future	F-22A does not increase noise levels under flight path although increased encroachment of residential development could contribute to increased noise complaints

5.2 Other Environmental Considerations

5.2.1 Relationship Between Short-Term Uses and Long-Term Productivity

CEQ regulations (Section 1502.16) specify that environmental analysis must address "…the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity." Special attention should be given to impacts that narrow the range of beneficial uses of the environment in the long term or pose a long-term risk to human health or safety. This section evaluates the short-term benefits of the proposal compared to the long-term productivity derived from not pursuing the proposal.

Short-term effects to the environment are generally defined as a direct consequence of a project in its immediate vicinity. Short-term effects could include localized disruptions and higher noise levels in some areas. There are minor changes proposed to the overall number of sorties flown out of Hickam AFB. Because of approach procedures to be implemented for F-22A aircraft under the Proposed Action, noise levels would not change significantly from current conditions. The military training that occurs in the airspace results in noise effects that are transitory in nature. Noise effects would be short term and would not be expected to result in permanent or long-term changes in wildlife or habitat use. Under the F-22A Proposed Action, these short-term uses would have a negligible cumulative effect.

The F-22A proposal largely involves changes in building structures, as well as introduction of a new aircraft, and would not significantly impact the long-term productivity of the land. As noted in Table 5.1-2, several projects could have construction time period overlaps which could increase demands for construction resources. The large Honolulu construction pool of skilled labor and materials would be expected to meet the demand. No negative cumulative socioeconomic effects are anticipated.

Continued use of chaff and flares would not significantly contribute to the long-term decline in the quality of waters of the North Pacific or impacts on wildlife under the training airspace.

5.2.2 Irreversible and Irretrievable Commitment of Resources

Irreversible and irretrievable resource commitments are related to the use of nonrenewable resources and the effects that the uses of these resources have on future generations. Irreversible effects primarily result from the use or destruction of a specific resource (e.g., energy and minerals) that cannot be replaced within a reasonable time frame. Irretrievable resource commitments involve the loss in value of an affected resource that cannot be restored as a result of the action.

For Hickam AFB, most impacts are short term and temporary (such as air emissions from construction) or longer lasting, but negligible (such as noise). Construction would use materials (e.g., metal, wood, concrete) and energy (fuel, electricity) that would be irretrievably lost. Air Force and personal vehicle use would consume fuel, oil, and lubricants.

Training operations would involve consumption of nonrenewable resources, such as gasoline used in vehicles, and jet fuel used in aircraft. Training would also involve commitment of chaff and flares. None of these activities would be expected to significantly decrease the availability of minerals or petroleum resources or have cumulative environmental consequences.

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7.0 LIST OF PREPARERS

Maj Charles Anthony, HIANG PAO
B.S., Communications, Broadcast Journalism, Ithaca College, 1984
Years of Experience: 16

Capt Ian Beltran, HIANG EMO, 154 CES/CEV
B.S., Mechanical Engineering, University of Hawaii at Manoa, 1997
Years of Experience: 10

Danyelle Callison, Project File
Years of Experience: 4

Chris Crabtree, Air Quality Specialist
B.A., Environmental Studies, University of California Santa Barbara, 1978
Years of Experience: 20

David M. Dischner, Hazardous Materials and Waste
B.A., Urban Affairs, Virginia Polytechnic Institute and State University, Blacksburg, 1974
Hazardous Materials Management Certificate, University of California, Riverside, 1988
Years of Experience: 30

Bill Doering, Biological Resources
B.A., Biology, University of San Diego, 1988
M.S., Idaho State University 1996
Years of Experience: 13

Lt Col Christopher Faurot, Deputy Chief, PACAF/A5F-22 PIO
B.S., Marine Transportation, U.S. Merchant Marine Academy, 1987
Years of Experience: 16

Jennifer Geeslin, Public Involvement Specialist
B.A., Speech Communications, Baylor University, 2002
Years of Experience: 5

J.D. Godwin, Attorney, 15 AW/JA
B.A., Law, Northwest Louisiana State, 1979
J.D., Law, Louisiana State University, 1992
LLM, Law, Army Judge Advocate General School, 1998
Years of Experience: 18

John Gorman, Air Quality Specialist
B.S., Atmospheric Sciences, University of California Los Angeles, 2001
Years of Experience: 1

Lorraine S. Gross, Senior Archaeologist
B.A., Anthropology, Pomona College, 1975
M.A., Anthropology, Washington State University, 1986
Years of Experience: 25

Julie Hong, NEPA Manager, HQ PACAF/A7NA
B.A., Environmental Science, University of Virginia, 1994
M.S., Environmental Science and Policy, Johns Hopkins University, 2000
Years of Experience: 13

Joseph A. Jimenez, Cultural Resources Manager
B.A., Anthropology, Idaho State University, 1984
M.A., Anthropology, Idaho State University, 1986
Years of Experience: 23

Irene Johnson, Socioeconomics and Environmental Justice
B.S., Economics, George Mason University, 1989
M.A., Economics, University of Washington, 1991
Years of Experience: 15

Ronnie D. Lanier, Chief Environmental Flight, 15 CES/CEV
B.S., Science, U.S. Air Force Academy, 1967
M.A., Personnel Management, State University of New York, 1978
AAS, Aviation Management, Belleville Area College, 1988
Years of Experience: 15

Claudia Laughlin, Graphics
Years of Experience: 10

Kim K. Matyskiela, Land Use and Transportation
B.S., Biology, James Madison University, 1990
Years of Experience: 14

Kevin Brent McBroom, GIS Analyst
Certified GIS Professional (by GISCI)
Years of Experience: 10

Tiffany Patrick, NEPA Manager, 15 CES/CEVP
B.S., Environmental Science, Biology, Mary Washington College, 2000
M.S., Environmental Management, University of Maryland University College, 2006
Years of Experience: 7

Kristi Regotti, Physical Resources
B.S., Political Science, Boise State University, 2001
M.P.A., Environmental and Natural Resource Policy, Boise State University, 2003
Years of Experience: 5

Richard Roller, HQ PACAF/A7NA
B.S., Agricultural Engineering, Virginia Tech, 1971
AFR Bioenvironmental Engineer, 1999 (Retired)
Certified Environmental Manager, 2000
Years of Experience: 24

Lt Col Christopher Sharp, Environmental Integration Branch Chief, HQ PACAF/A7NA
B.S., Electrical Engineering, Texas A&M University, 1987
M.S., Engineering and Environmental Management, Air Force Institute of Technology, 2001
Years Experience: 18

2Lt Kyle Slick, Base NEPA Manager, 15 CES/CEVP
B.S., Mechanical Engineering, Clarkson University, 2005
Years of Experience: 1

Christa Stumpf, Project Manager
B.S., Resource Recreation and Tourism, University of Idaho, 1995
M.S., Forest Resources and Land Use Planning, University of Idaho, 1996
Years of Experience: 12

Lt Col Gary Teed, 154 CES
B.S., Mechanical Engineering, Norwich University, 1981
M.S., Management Information Systems, Boston University, 1988
P.E., Mechanical Engineering, State of Hawaii, 1998
Years of Experience: 24

Robert E. Van Tassel, Program Manager
B.A., Economics, University of California, Santa Barbara, 1970
M.A., Economics, University of California, Santa Barbara, 1972
Years of Experience: 33

Kimberly Wilson, Production Manager
Years of Experience: 20

William Wuest, Airspace and Noise Analyst
M.P.A., Public Administration, Auburn University, 1974
B.S., Political Science, St. Joseph's College, 1963
Years of Experience: 39

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Appendix A
Characteristics of Chaff

APPENDIX A CHARACTERISTICS OF CHAFF

Chaff is currently authorized for use in Hawaiian Warning Areas. Chaff consists of strands, each thinner than a human hair, of an aluminum-coated crystalline silica core. When released from an aircraft, chaff initially forms a rough sphere, then disperses in the air and eventually drifts to the surface. The chaff effectively reflects radar signals in various bands (depending on the length of the chaff fibers) and spreads out to form a brief electronic "cloud" of reflected signals on a radar screen. When the aircraft is obscured from radar detection by the cloud, the aircraft can safely maneuver or leave an area.

Chaff is made as small and light as possible so that it will remain in the air long enough to confuse enemy radar. The chaff fibers are thinner than a human hair (i.e., generally 25.4 microns in diameter), and range in length from 0.3 to over 1 inch. The weight of chaff material in the RR-180A/AL chaff cartridge is approximately 95 grams or 3.35 ounces (Air Force 1997). RR-180A/AL is combat chaff in a cartridge designed for use by F-22A aircraft. Combat chaff dipoles are cut to disguise the aircraft and produce a more realistic training experience in threat avoidance. Based on experience with the stealth airframe and chaff discharge from the F-22A, the chaff approved for use by the F-22A is the RR-180A/AL combat chaff with six Mylar wrapping materials that help the chaff leave the aircraft. For the purpose of this EA, RR-180A/AL type dipole cut chaff with six approximately 2-inch by 4-inch Mylar wrappers is assumed to be used for training in Hawaiian airspace.

Chaff Composition

Chaff is comprised of silica, aluminum, and stearic acid, which are generally prevalent in the environment. Silica (silicon dioxide) belongs to the most common mineral group, silicate minerals. Silica is environmentally inert and does not present an environmental concern with respect to soil or water chemistry. Aluminum is the third most abundant element in the earth's crust, forming some of the most common minerals, such as feldspars, micas, and clays. Natural soil concentrations of aluminum ranging from 10,000 to 300,000 parts per million have been documented (Lindsay 1979). These levels vary depending on numerous environmental factors, including climate, parent rock materials from which the soils were formed, vegetation, and soil moisture alkalinity/acidity. The solubility of aluminum is greater in acidic and highly alkaline soils than in neutral pH conditions. Aluminum eventually oxidizes to Al_2O_3 (aluminum oxide) over time, depending on its size and form and the environmental conditions.

The chaff fibers have an anti-clumping agent (Neofat, which is 90 percent stearic acid and 10 percent palmitic acid) to assist with rapid dispersal of the fibers during deployment (United States Air Force [Air Force] 1997). Stearic acid is an animal fat that degrades when exposed to light and air.

A single bundle of chaff consists of the filaments in an 8-inch long rectangular tube or cartridge, a plastic piston, a cushioned spacer, and two plastic end caps (1/8-inch thick, 1-inch x 1-inch or 1-inch x 2-inch). The chaff dispenser remains in the aircraft. The plastic end caps and spacer fall to the ground (or water, in Warning Areas) when chaff is dispensed. The spacer is a spongy material (felt) designed to absorb the force of release. Table 1 lists the components of the silica core and the aluminum coating. Table 2 presents the characteristics of RR-180A/AL chaff.

Table 1. Components of Chaff

Element	*Chemical Symbol*	*Percent (by weight)*
Silica Core		
Silicon dioxide	SiO_2	52-56
Alumina	Al_2O_3	12-16
Calcium Oxide and Magnesium Oxide	CaO and MgO	16-25
Boron Oxide	B_2O_3	8-13
Sodium Oxide and Potassium Oxide	Na_2O and K_2O	1-4
Iron Oxide	Fe_2O_3	1 or less
Aluminum Coating (Typically Alloy 1145)		
Aluminum	Al	99.45 minimum
Silicon and Iron	Si and Fe	0.55 maximum
Copper	Cu	0.05 maximum
Manganese	Mn	0.05 maximum
Magnesium	Mg	0.05 maximum
Zinc	Zn	0.05 maximum
Vanadium	V	0.05 maximum
Titanium	Ti	0.03 maximum
Others		0.03 maximum

Source: Air Force 1997

Table 2. Characteristics of RR-180A/AL Chaff

Attribute	*Details*
Aircraft	F-15, F-22A (assumed)
Composition	Aluminum coated silica
Ejection Mode	Pyrotechnic
Configuration	Rectangular tube cartridge
Size	8 x 1 x 1 inches (8 cubic inches)
Number of Dipoles	Approximately 5 million
Dipole Size (cross-section)	1 mil (diameter)
Impulse Cartridge	BBU-35/B
Other Comments	Cartridge stays in aircraft

Source: Air Force 1997, adapted from RR-188 chaff.

The F-22A chaff cartridge design with Mylar wrapping is less likely to leave debris of any kind in the dispenser bay yet still provides robust chaff dispensing. Figure 1 is a photograph of this type of RR-180A/AL chaff cartridge. The RR-180A/AL has two 1-inch by 1/2-inch by 1/2-inch end caps, two pistons of the same size, and six Mylar wraps that facilitate deployment. The end caps, pistons, and six approximately 2-inch by 4-inch mylar pieces fall to the ground with each chaff cartridge deployed. The rubber bands in the photograph are removed before loading.

RR-180A/AL chaff cartridges have chaff dipoles cut to combat lengths and are permitted for use in offshore Warning Areas.

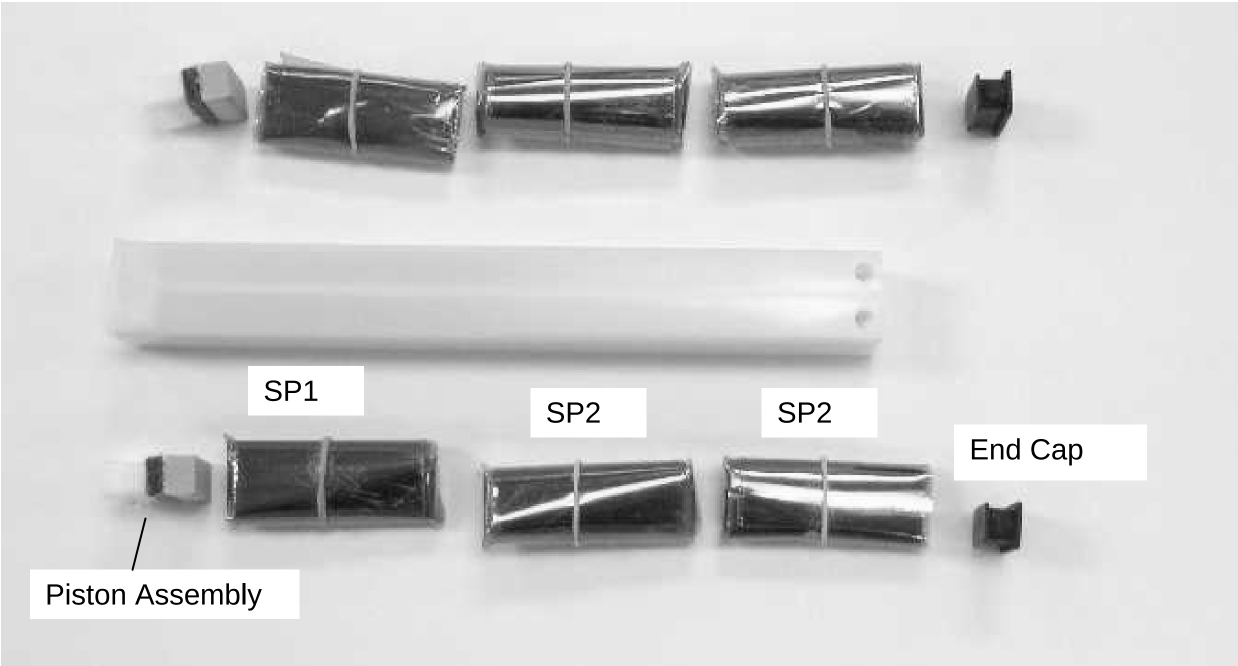

Figure 1. RR-180A/AL Layout

Chaff Ejection

Chaff is typically ejected pyrotechnically using a BBU-35/B or equivalent impulse cartridge. Pyrotechnic ejection uses hot gases generated by a small explosive impulse charge. The gases push the pistons down the chaff-filled tube. The plastic end caps with attached felt spacers are ejected, followed by the chaff fibers wrapped in Mylar, and, in the case of F-22A chaff, the pistons. The plastic tube remains within the aircraft. Table 3 lists the characteristics of BBU-35/B impulse cartridges used to pyrotechnically eject chaff.

Table 3. BBU-35/B Impulse Charges Used to Eject Chaff

Component	*BBU-35/B*
Overall Size Overall Volume Total Explosive Volume	0.625 inches x 0.530 inches 0.163 $inches^3$ 0.034 $inches^3$
Bridgewire	Trophet A 0.0025 inches x 0.15 inches
Initiation Charge	0.008 cubic inches 130 mg 7,650 psi boron 20% potassium perchlorate 80% *
Booster Charge	0.008 cubic inches 105 mg 7030 psi boron 18% potassium nitrate 82%
Main Charge	0.017 cubic inches 250 mg loose fill RDX ** pellets 38.2% potassium perchlorate 30.5% boron 3.9% potassium nitrate 15.3% super floss 4.6% Viton A 7.6%

Source: Air Force 1997

Upon release from an aircraft, chaff forms an electronic "cloud" approximately 30 meters in diameter in less than one second under normal conditions. Quality standards for chaff cartridges require that they demonstrate ejection of 98 percent of the chaff in undamaged condition, with a reliability of 95 percent at a 95 percent confidence level. They must also be able to withstand a variety of environmental conditions that might be encountered during storage, shipment, and operation.

Table 4 lists performance requirements for chaff.

Table 4. Performance Requirements for Chaff

Condition	*Performance Requirement*	
High Temperature	Up to +165 degrees Fahrenheit	
Low Temperature	Down to –65 °F	
Temperature Shock	Shock from –70 °F to +165 °F	
Temperature Altitude	Combined temperature altitude conditions up to 70,000 feet	
Humidity	Up to 95 percent relative humidity	
Sand and Dust	Sand and dust encountered in desert regions subject to high sand dust conditions and blowing sand and dust particles	
Accelerations/Axis	G-Level	Time (minute)
Transverse-Left (X)	9.0	1
Transverse-Right (-X)	3.0	1
Transverse (Z)	4.5	1
Transverse (-Z)	13.5	1
Lateral-Aft (-Y)	6.0	1
Lateral-Forward (Y)	6.0	1
Shock (Transmit)	Shock encountered during aircraft flight	
Vibration	Vibration encountered during aircraft flight	
Free Fall Drop	Shock encountered during unpackaged item drop	
Vibration (Repetitive)	Vibration encountered during rough handling of packaged item	
3- Foot Drop	Shock encountered during rough handling of packaged item	

Note: Cartridge must be capable of total ejection of chaff from the cartridge liner under these conditions.
Source: Air Force 1997

Policies and Regulations on Chaff Use

Current Air Force policy on use of chaff and flares was established by the Airspace Subgroup of Headquarter Air Force Flight Standards Agency in 1993. It requires units to obtain frequency clearance from the Air Force Frequency Management Center and the FAA prior to using chaff to ensure that training with chaff is conducted on a non-interference basis. This ensures electromagnetic compatibility between the FAA, the Federal Communications Commission, and Department of Defense (DoD) agencies. The Air Force does not place any restrictions on the use of chaff provided those conditions are met (Air Force 1997).

Air Force Instruction (AFI) 13-201, U.S. Air Force Airspace Management, September 2001. This guidance establishes practices to decrease disturbance from flight operations that might cause adverse public reaction. It emphasizes the Air Force's responsibility to ensure that the public is protected to the maximum extent practicable from hazards and effects associated with flight operations.

AFI 11-214 Aircrew and Weapons Director and Terminal Attack Controller Procedures for Air Operations, July 1994. This instruction delineates procedures for chaff and flare use. It prohibits use unless in an approved area.

References

Air Force. 1997. *Environmental Effects of Self-Protection Chaff and Flares*. Prepared for Headquarters Air Combat Command, Langley Air Force Base, Virginia.

_____. 1999. *Description of the Proposed Action and Alternatives (DOPAA) for the Expansion of the Use of Self-Protection Chaff and Flares at the Utah Test and Training Range, Hill Air Force Base, Utah*. Prepared for Headquarters Air Force Reserve Command Environmental Division, Robins AFB, Georgia.

Appendix B
Characteristics and Analysis of Flares

APPENDIX B CHARACTERISTICS AND ANALYSIS OF FLARES

1.0 Introduction

The F-22A employs MJU-10/B self-protection flares. Self-protection flares are magnesium pellets that, when ignited, burn for 3.5 to 5 seconds at 2,000 degrees Fahrenheit. The burn temperature is hotter than the exhaust of an aircraft, and therefore attracts and decoys heat-seeking weapons and sensors targeted on the aircraft. Flares are used in pilot training to develop the near instinctive reactions to a threat that are critical to combat survival. This appendix describes flare composition, ejection, risks, and associated regulations.

2.0 Flare Composition

Self-protection flares are primarily mixtures of magnesium and Teflon (polytetrafluoroethylene) molded into rectangular shapes (United States Air Force [Air Force] 1997). Longitudinal grooves provide space for small amounts of materials that aid in ignition such as the following:

- First fire materials: potassium perchlorate, boron powder, magnesium powder, barium chromate, Viton A, or Fluorel binder.
- Immediate fire materials: magnesium powder, Teflon, Viton A, or Fluorel
- Dip coat: magnesium powder, Teflon, Viton A or Fluorel

Typically, flares are wrapped with an aluminum-coated mylar or filament-reinforced tape (wrapping) and inserted into an aluminum (0.03 inches thick) case that is closed with a felt spacer and a plastic end cap (Air Force 1997). The top of the case has a pyrotechnic impulse cartridge that is activated electrically to produce hot gases that push a piston, a safe and initiation (S&I) device, the flare material, and the end cap out of the aircraft into the airstream. Table 1 provides a description of MJU-10/B and, for comparison, MJU-7A/B flare components. Existing Hawaii Air National Guard (HIANG) F-15 aircraft also use the MJU-7A/B flare. Typical flare composition and debris are summarized in Table 2. Figure 1 is an illustration of an MJU-10/B flare.

Table 1. Description of MJU-10/B and MJU-7 A/B Flares

Attribute	*MJU-10/B*	*MJU-7A/B*
Aircraft	F-15, F-22A	F-15
Mode	Semi-Parasitic[1]	Semi-Parasitic
Configuration	Rectangle	Rectangle
Size	2 x 2 x 8 inches (32 cubic inches)	1 x 2 x 8 inches (16 cubic inches)
Impulse Cartridge	BBU-36/B	BBU-36/B
Safe and Initiation Device (S&I)	Slider Assembly	Slider Assembly
Weight (nominal)	40 ounces	13 ounces

Note: 1. Semi-parasitic means the flare ignition begins as part of the flare ejection process.

Table 2. Typical Composition of MJU-10/B and MJU-7A/B Self-Protection Flares

Part	*Components*
Combustible	
Flare Pellet	Polytetrafluoroethylene (Teflon) $(-[C_2F_4]_n$ – n=20,000 units) Magnesium (Mg) Fluoroelastomer (Viton, Fluorel, Hytemp)
First Fire Mixture	Boron (B) Magnesium (Mg) Potassium perchlorate ($KClO_4$) Barium chromate ($BaCrO_4$) Fluoroelastomer
Immediate Fire/ Dip Coat	Polytetrafluoroethylene (Teflon) $(-[C_2F_4]_n$ – n=20,000 units) Magnesium (Mg) Fluoroelastomer
Assemblage (Residual Components)	
Aluminum Wrap	Mylar or filament tape bonded to aluminum tape
End Cap	Plastic (nylon)
Felt Spacers	Felt pads (0.25 inches by cross section of flare)
Safe & Initiation (S&I) Device	Plastic (nylon, tefzel, zytel)
Piston	Plastic (nylon, tefzel, zytel)

Source: Air Force 1997

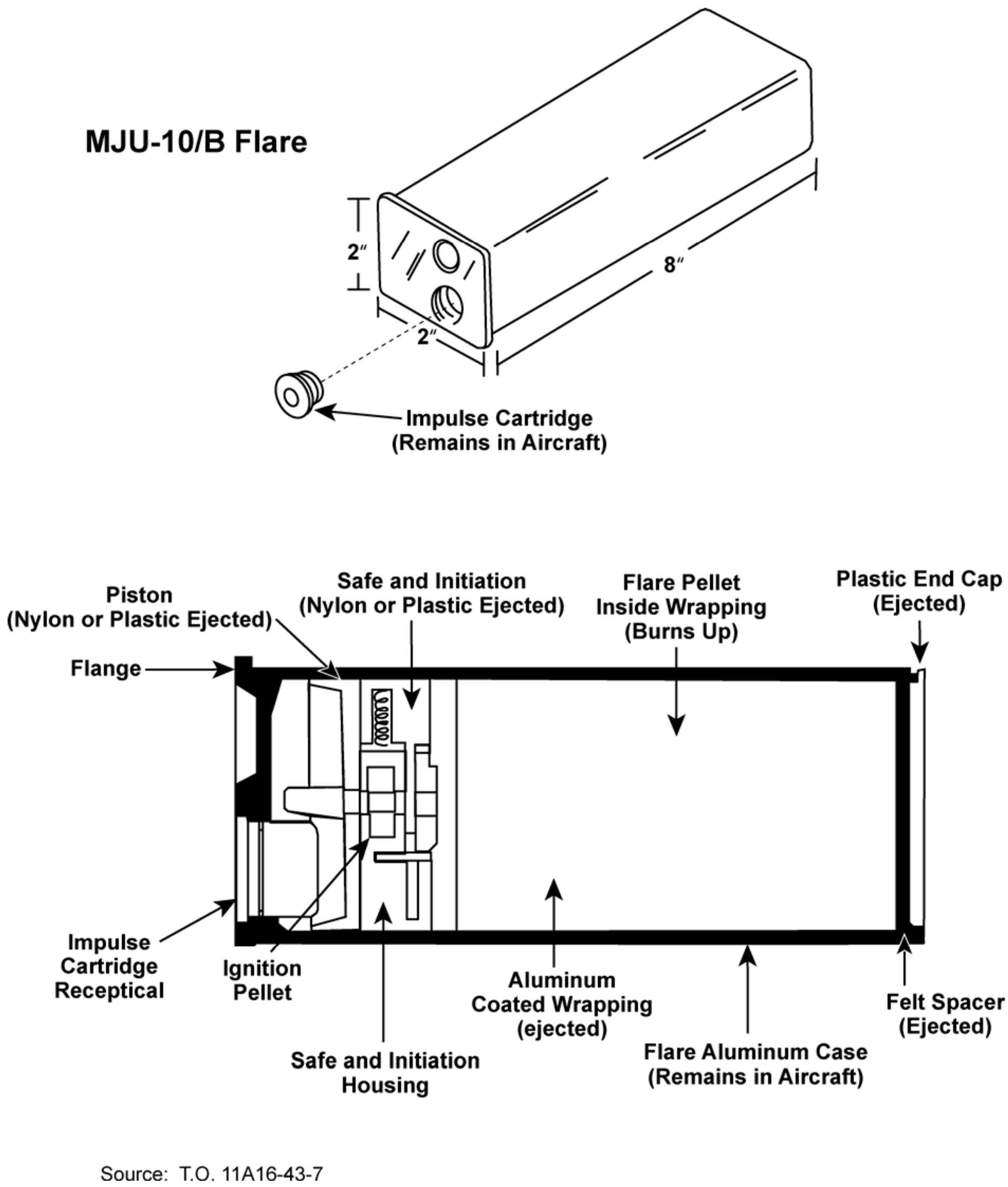

Figure 1. MJU-10/B Flare

3.0 Flare Ejection

The MJU-10/B is a semi-parasitic type flare that uses a BBU-36/B impulse cartridge. In these flares, a slider assembly incorporates an initiation pellet (640 milligrams of magnesium, Teflon, and Viton A or Fluorel binder). This pellet is ignited by the impulse cartridge, and hot gases reach the flare as the slider exits the case, exposing a fire passage from the initiation pellet to the first fire mixture on top of the flare pellet. Table 3 describes the components of BBU-36/B impulse charges.

Flares are tested to ensure they meet performance requirements in terms of ejection, ignition, and effective radiant intensity. If the number of failures exceeds the upper control quality assurance acceptance level, the flares are returned to the manufacturer. A statistical sample is taken to ensure that approximately 99 percent must be judged reliable for ejection, ignition, and intensity. Flare failure would occur if the flare failed to eject, did not burn properly, or failed to ignite upon ejection. For training use within the airspace, a dud flare would be one that successfully ejected but failed to ignite. That probability of a dud flare on the ground is estimated to be 0.01 percent based upon dud flares located during military range cleanup.

4.0 Risks Associated with Flare Use

Environmental risks associated with the use of defensive flares fall within two main categories: the risk of fire from a flare and the risk of being struck by a residual flare component.

Fire Risk. Fire risk is not associated with F-22A flares use in Hawaiian Warning Areas. Fire risk stems from an unlikely but possible scenario that results in the flare reaching the ground or vegetation while still burning. The flare burn-out rate is shown in Table 4. Defensive flares typically burn out in 3.5 to 5 seconds, during which time the flare will have fallen between 200 and 400 feet. Specific defensive flare burn-out rates are classified. Table 4 is based on conditions that assume zero aerodynamic drag and a constant acceleration rate of 32.2 feet per second per second.

$D = (V_o * T) +(0.5 * (A * T^2))$

Where:

D = Distance
Vo = Initial Velocity = 0
T = Time (in Seconds)
A = Acceleration

There is essentially no potential fire risk from on-going or proposed flare use in Hawaiian Warning Areas.

Table 3. Components of BBU-36/B Impulse Charges

Component	*BBU-36/B*
Overall Size Overall Volume Total Explosive Volume	0.740 x 0.550 inches 0.236 cubic inches 0.081 cubic inches
Bridgewire	Trophet A
Closure Disk	Scribed disc, washer
Initiation Charge	
Volume	0.01 cubic inches
Weight	100 mg
Compaction	6,200 psi
Composition	42.5% boron 52.5 % potassium perchlorate 5.0% Viton A
Booster Charge	
Volume	0.01 cubic inches
Weight	150 mg
Compaction	5,100 psi
Composition	20% boron 80% potassium nitrate
Main Charge	
Volume	0.061 cubic inches
Weight	655 mg
Compaction	Loose fill
Composition	Hercules #2400 smokeless powder (50-77% nitrocellulose, 15-43% nitroglycerine)

Source: Air Force 1997

Table 4. Flare Burn-out Rates

Time (in Sec)	*Acceleration*	*Distance (in feet)*
0.5	32.2	4.025
1.0	32.2	16.100
1.5	32.2	36.225
2.0	32.2	64.400
2.5	32.2	100.625
3.0	32.2	144.900
3.5	32.2	197.225
4.0	32.2	257.600
4.5	32.2	326.025
5.0	32.2	402.500
5.5	32.2	487.025
6.0	32.2	579.600
6.5	32.2	680.225
7.0	32.2	788.900

Note: Initial vertical velocity is assumed to be zero.

Flare Strike Risk. Residual flare materials are those that are not completely consumed during ignition and fall to the surface, creating the risk of striking something. Residual material from the MJU-10/B consists of an end cap, an initiation assembly (safe and initiation device [S&I]), a piston, one or two felt spacers, and an aluminum-coated Mylar wrapper (Table 5). The wrapper may be partially consumed during ignition, so the wrapping residual material could range in size from the smallest size, 2 inches by 2 inches, to the largest size, 4 inches by 13 inches. The size of the residual wrapping material would depend upon the amount of combustion that occurred as the flare was deployed.

Table 5. Residual Material from MJU-10/B Flares

Component	*Weight*
MJU-10/B	
End cap	0.0144 pounds
Safe & Initiation (S&I) device	0.0453 pounds
Piston	0.0144 pounds
Felt spacer	0.0025 pounds
Wrapper (4 inches x 13 inches)	0.0430 pounds

After ignition, as described in section 3.0, most residual components of the MJU-10/B flare have high surface-to-mass ratios and are not judged capable of damage or injury when they impact the surface. One component of the MJU-10/B flare, the S&I device, has a weight of approximately 0.725 ounces (0.0453 pounds). It is sized and shaped such that it is capable of achieving a terminal velocity that could cause injury if it struck a person or animal on the surface.

The following discussion addresses the likelihood of an S&I device striking a person and the effect if such a strike were to occur.

Aircraft training flights are distributed randomly and uniformly within the 30,000 square miles of Warning Areas used for training. Flare component release altitudes and angles of release are sufficiently random that surface impact locations of flare materials are also assumed to be uniformly distributed under the airspace.

For any particular residual component of a released flare, the conditional probability that it strikes a particular object is equal to the ratio of the object area to the total area under the airspace. For multiple objects (i.e., people, structures, vehicles), the probability of striking any one object is the ratio of the sum of object areas to the airspace. The frequency of a residual component striking one of many objects is the frequency of releasing residual components times the conditional probability of striking one of the many objects per given release. The sheer size of the airspace, the extremely small number of objects on the surface under the Warning Areas, and the number of pieces of flare material that would strike the surface make the probability of a piece of flare material striking an individual or animal and causing injury so minute to be nearly equivalent to zero.

5.0 Policies and Regulations Addressing Flare Use

Air Force policy on flare use was established by the Airspace Subgroup of Headquarters Air Force Flight Standards Agency in 1993 (Memorandum from John R. Williams, 28 June 1993) (Air Force 1997). This policy permits flare drops over military-owned or controlled land and in Warning Areas. Flare drops are permitted in Military Operations Areas (MOAs) and Air Traffic Control Assigned Airspaces (ATCAAs) only when an environmental analysis has been completed. Minimum altitudes must be adhered to. Flare drops must also comply with established written range regulations and procedures.

Air Force Instruction (AFI) 11-214 prohibits using flare systems except in approved areas with intent to dispense, and sets certain conditions for employment of flares. Flares are authorized over government-owned and controlled property and over-water Warning Areas with no minimum altitude restrictions when there is no fire hazard. If a fire hazard exists, minimum altitudes will be maintained in accordance with the applicable directive or range order. An Air Combat Command supplement to Air Force Instruction (AFI) 11-214 (15 October 2003) prescribes a minimum flare employment altitude of 2,000 feet above ground level (AGL) over non-government owned or controlled property (Air Force 1997).

References

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Tennessee Valley Authority. 2003. On the Air, Technical Notes on Important Air Quality Issues, Outdoor Ozone Monitors Over-Estimate Actual Human Ozone Exposure. http://www.tva.gov/environment/air/ontheair/pdf/outdoor.pdf

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Appendix C
Agency Coordination

Interagency and Intergovernmental Coordination for Environmental Planning (IICEP) letters provided by the Air Force in Fall 2006 included map attachments. Since that time, these maps have been refined.

Sample IICEP Letter

HAWAII AIR NATIONAL GUARD
Headquarters, 154th Wing

OCT 27 2006

MEMORANDUM FOR U.S. Department of Transportation
Region 10 Federal Transit Administration
915 Second Ave., Ste. 3142
Seattle, WA 98174-1095

FROM: SAIC
Attention: Ms. Kim Matyskiela
3049 Ualena Street, Suite 600
Honolulu, HI 96819

SUBJECT: F-22 Beddown Environmental Impact Analysis Process

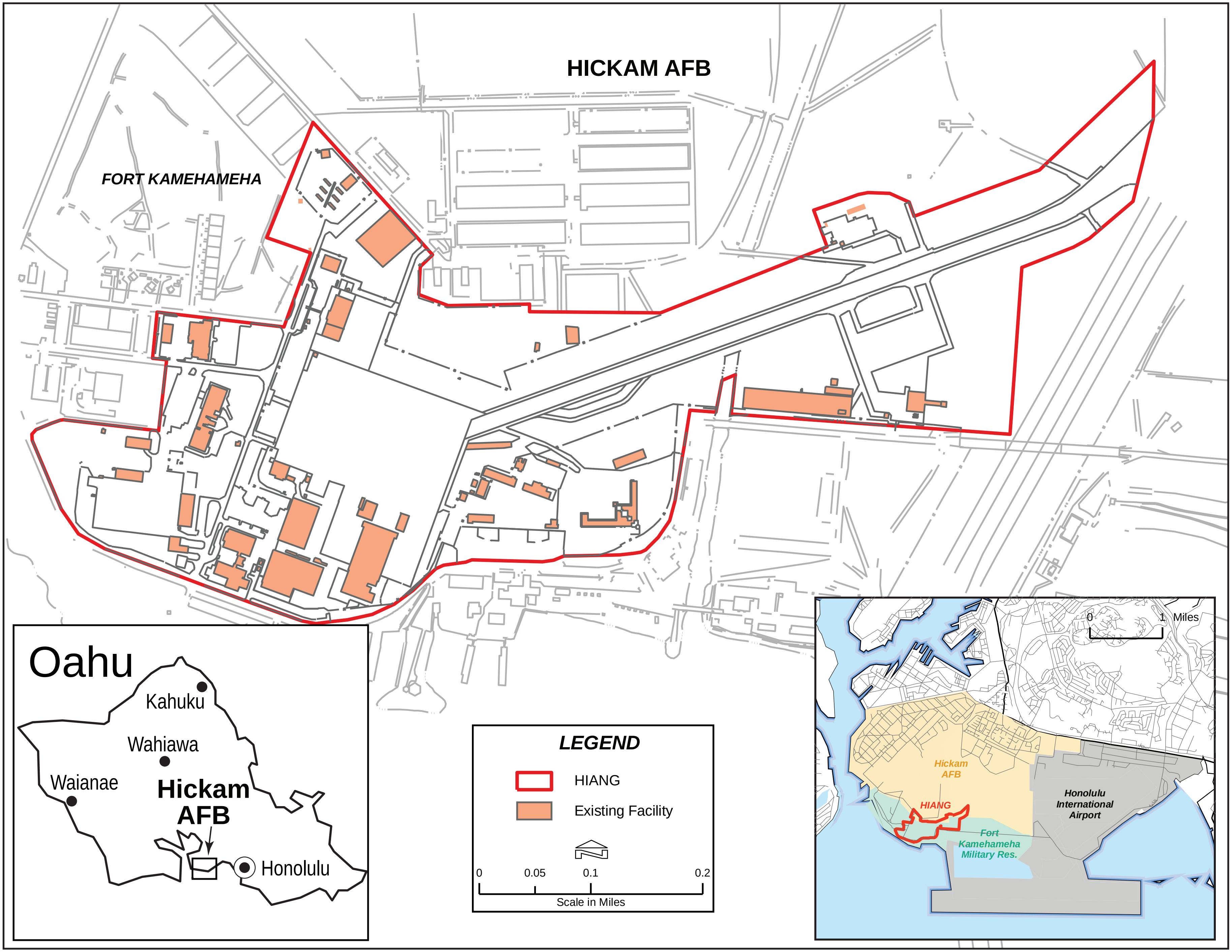
The Hawaii Air National Guard (HIANG), 154th Wing, is preparing an environmental analysis to assess the potential environmental consequences of a proposal to replace the existing squadron of F-15 fighter aircraft with F-22 fighter aircraft. The environmental analysis will address changes in facilities located in the HIANG area on Hickam AFB to support the proposed beddown (refer to Attachment 1), changes in personnel, and a No-Action alternative that does not beddown F-22 aircraft at Hickam AFB at this time. F-22 training is proposed for existing over water airspace currently utilized by F-15 aircraft (refer to Attachment 2). The proposal under consideration does not require expansion of the existing base or airspace.

A community outreach scoping meeting is scheduled to provide interested parties the opportunity to learn more about this proposal and provide input to help define the environmental analysis. You are encouraged to attend and participate. The meeting will be held at the Radford High School Cafeteria located on 4361 Salt Lake Blvd., Honolulu, HI on November 9, 2006 from 7:00 to 9:00 p.m. Your comments will be used to help refine and shape the proposal.

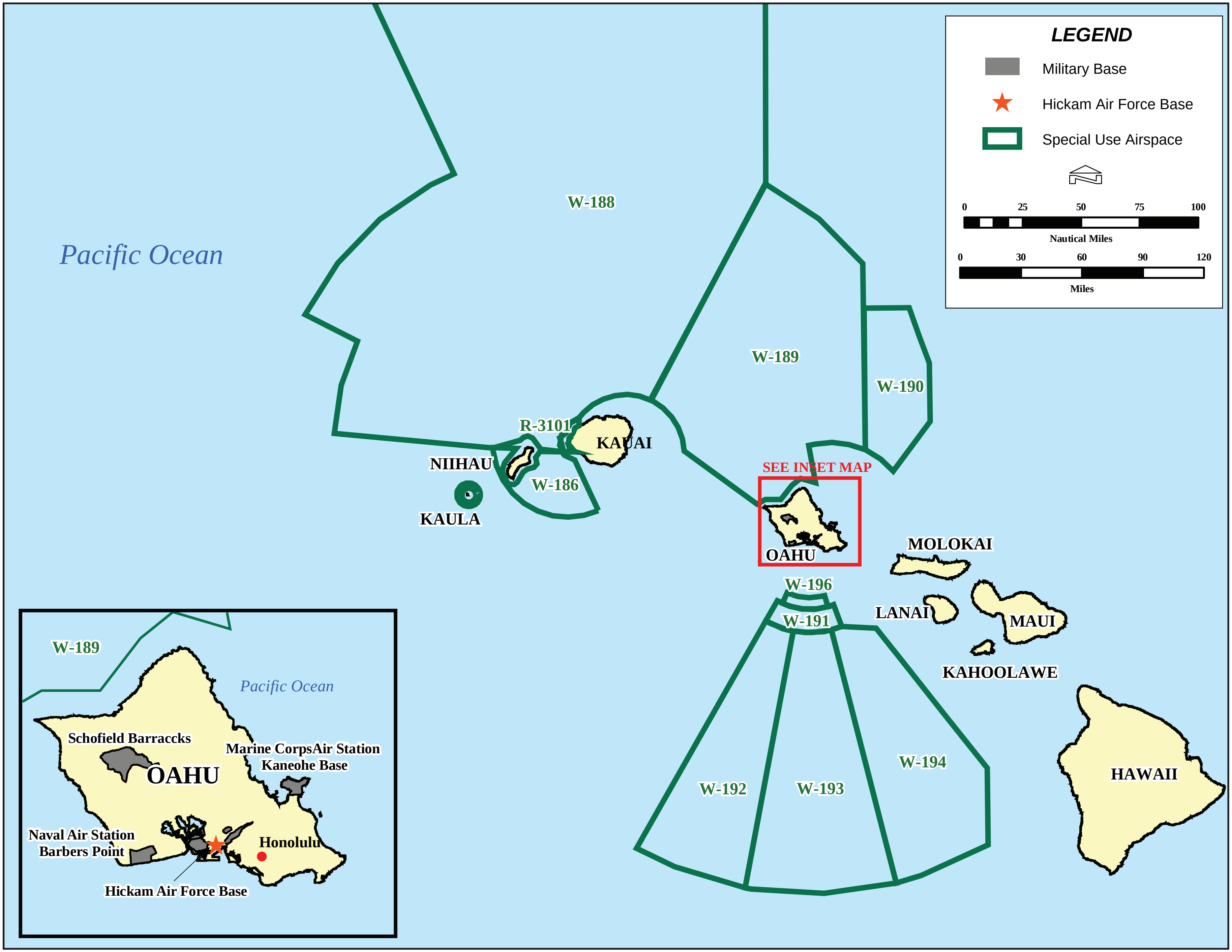
As part of this environmental analysis, the HIANG would like to receive any questions or comments you have regarding the proposed beddown. We would appreciate your sending specific questions or comments about the proposal to replace the F-15 aircraft with F-22 aircraft to the above address by November 30, 2006. If you have any general questions, please contact Major Chuck Anthony, HIANG Public Affairs, at (808) 733-4258.

PETER S. PAWLING, Brigadier General, HIANG
Commander

Attachments:
1. Hickam AFB Map
2. Hickam Special Use Training Airspace



Hickam AFB Map
Attachment 1



Hickam Special Use Training Airspace
Attachment 2

F-22A EIAP Distribution Database

LAST NAME	FIRST NAME	COMPANY	CITY	STATE	PROVIDED DRAFT EA COMMENTS
		Ahupuaa Action Alliance	Honolulu	HI	☐
		Aiea Public Library	Aiea	HI	☐
		Association of Hawaiian Civic Clubs	Honolulu	HI	☐
		Commander Navy Region Hawaii	Pearl Harbor	HI	☐
		Conservation Council for Hawaii	Honolulu	HI	☐
		Department of Health Hazard Evaluation and Emergency Response Office	Honolulu	HI	☐
		Department of Land and Natural Resources	Kapolei	HI	☐
		Department of Transportation	Honolulu	HI	☐
		Division of Conservation and Resource Enforcement	Honolulu	HI	☐
		Division of Forestry and Wildlife	Honolulu	HI	☐
		Earthtrust	Kailua	HI	☐
		Enterprise Honolulu	Honolulu	HI	☐
		Environmental Health and Safety Office	Honolulu	HI	☐
		Environmental Protection Agency	Honolulu	HI	☐
		EPA Region IX	San Francisco	CA	☐
		Ewa Beach Public & School Library	Ewa Beach	HI	☐
		Hawaii Audubon Society	Honolulu	HI	☐
		Hawaii State Library	Honolulu	HI	☐
		Hickam AFB Library	Hickam AFB	HI	☐
		Kaneohe Public Library	Kaneohe	HI	☐
		Kapolei Public Library	Kapolei	HI	☐
		Land Division	Honolulu	HI	☐
		Marine Corps Base Hawaii, Consolidated	MCBH Kaneohe Bay	HI	☐
		National Park Service	Honolulu	HI	☐
		Naval Facilities Engineering Command	Pearl Harbor	HI	☐
		Navy Public Works Center	Pearl Harbor	HI	☐
		Office of Environmental Quality Control	Honolulu	HI	☐
		Pearl City Public Library	Pearl City	HI	☐
		Salt Lake Moanalua Public Library	Honolulu	HI	☐
		The Nature Conservancy of Hawaii	Honolulu	HI	☐
		U.S. Army Corps of Engineers, Regulatory Branch	Fort Shafter	HI	☐
		U.S. Army Installation Management Agency, Pacific Region	Fort Shafter	HI	☐
		U.S. Department of Transportation	Seattle	WA	☐
		University of Hawaii, Manoa	Honolulu	HI	☐
		Wahiawa Public Library	Wahiawa	HI	☐
		Waimanalo Public & School Library	Waimanalo	HI	☐

LAST NAME	FIRST NAME	COMPANY	CITY	STATE	PROVIDED DRAFT EA COMMENTS
Abercrombie	The Honorable Neil	US House of Representatives	Washington	DC	☐
Abercrombie	The Honorable Neil	US House of Representatives	Honolulu	HI	☐
Aiona Jr	James R	Office of the Lieutenant Governor	Honolulu	HI	☐
Akaka	The Honorable Daniel	US Senate	Washington	DC	☐
Akaka	The Honorable Daniel	US Senate	Honolulu	HI	☐
Belatti	The Honorable Della Au	Hawaii State Legislature	Honolulu	HI	☐
Berg	The Honorable Lyla	Hawaii State Legislature	Honolulu	HI	☐
Brower	The Honorable Tom	Hawaii State Legislature	Honolulu	HI	☐
Cabanilla	The Honorable Rida	Hawaii State Legislature	Honolulu	HI	☐
Caldwell	The Honorable Kirk	Hawaii State Legislature	Honolulu	HI	☐
Carter	Michael	U.S. Department of Transportation	Washington	DC	☐
Ching	The Honorable Corinne	Hawaii State Legislature	Honolulu	HI	☐
Chun Oakland	The Honorable Suzanne	Hawaii State Legislature	Honolulu	HI	☐
Cox	Carroll	EnviroWatch, Inc	Mililani	HI	☐
Cunningham	Kristine		Kailua	HI	☐
Dinill	Daniel	Hawaii Community Development Authority	Honolulu	HI	☐
Ebisu, P.E.	Yoichi	Y. Ebisu & Associates	Honolulu	HI	☑
Espero	The Honorable Will	Hawaii State Legislature	Honolulu	HI	☐
Evans	The Honorable Cindy	Hawaii State Legislature, Public Safety & Military Affairs	Honolulu	HI	☐
Faulkner	Kiersten	Historic Hawaii Foundation	Honolulu	HI	☐
Finnegan	The Honorable Lynn	Hawaii State Legislature	Honolulu	HI	☐
Finnegan	The Honorable Lynn	Hawaii State Legislature, Public Safety & Military Affairs	Honolulu	HI	☐
Fukunaga	The Honorable Carol	Hawaii State Legislature	Honolulu	HI	☐
Har	The Honorable Sharon	Hawaii State Legislature, Public Safety & Military Affairs Committee	Honolulu	HI	☐
Haraga	Rodney K.	Department of Transportation	Honolulu	HI	☐
Hemmings	The Honorable Fred	Hawaii State Legislature, Intergovernmental and Military Affairs	Honolulu	HI	☐
Henkin	David	Earthjustice	Honolulu	HI	☐
Hirono	The Honorable Mazie	U.S. House of Representatives	Honolulu	HI	☐
Hirono	The Honorable Mazie	U.S. House of Representatives	Washington	DC	☐
Ige	The Honorable David	Hawaii State Legislature	Honolulu	HI	☐
Ihara	The Honorable Les	Hawaii State Legislature	Honolulu	HI	☐
Inouye	The Honorable Lorraine	Hawaii State Legislature, Intergovernmental and Military Affairs	Honolulu	HI	☐
Inouye	The Honorable Daniel	U.S. Senate	Honolulu	HI	☐
Inouye	The Honorable Daniel	US Senate	Washington	DC	☐
Karamatsu	The Honorable Jon Riki	Hawaii State Legislature	Honolulu	HI	☐
Kim	The Honorable Donna M.	Hawaii State Legislature	Honolulu	HI	☐
Kobayashi	Marylou	Hawaii Office of State Planning	Honolulu	HI	☐
Kuloloid	Manuel		Kahului, Maui	HI	☐
Kunimoto	Sandra Lee	Department of Agriculture	Honolulu	HI	☐
Lee	Robert G. F.	Department of Defense	Honolulu	HI	☐

LAST NAME	FIRST NAME	COMPANY	CITY	STATE	PROVIDED DRAFT EA COMMENTS
Lee	The Honorable Marilyn	Hawaii State Legislature, Public Safety & Military Affairs	Honolulu	HI	☐
Lingle	The Honorable Linda	Office of the Governor	Honolulu	HI	☐
Liu	Theodore	Department of Business, Economic Development, and Tourism	Honolulu	HI	☐
Luke	The Honorable Sylvia	Hawaii State Legislature	Honolulu	HI	☐
Luke	The Honorable Sylvia	Hawaii State Legislature, Public Safety & Military Affairs	Honolulu	HI	☐
Manahan	The Honorable Joey	Hawaii State Legislature	Honolulu	HI	☐
Marumoto	The Honorable Barbara	Hawaii State Legislature	Honolulu	HI	☐
McKelvey	The Honorable Angus	Hawaii State Legislature, Public Safety & Military Affairs	Honolulu	HI	☐
Menor	The Honorable Ron	Hawaii State Legislature	Honolulu	HI	☐
Mikulina	Jeff	Sierra Club	Honolulu	HI	☐
Mizuno	The Honorable John	Hawaii State Legislature	Honolulu	HI	☐
Molina	Don		Waipahu	HI	☐
Nakagawa	John	Hawaii Coastal Zone Management Program	Honolulu	HI	☐
Nakasone	The Honorable Bob	Hawaii State Legislature, Public Safety & Military Affairs	Honolulu	HI	☐
Namu'o	Clyde	Office of Hawaiian Affairs	Honolulu	HI	☑
Newman	Jeff	US Fish and Wildlife Service Pacific Islands Office	Honolulu	HI	☐
Nishihara	The Honorable Clarence	Hawaii State Legislature	Honolulu	HI	☐
Nishimoto	The Honorable Scott	Hawaii State Legislature	Honolulu	HI	☐
Nishimoto	The Honorable Scott	Hawaii State Legislature, Public Safety & Military Affairs	Honolulu	HI	☐
Okada	Olson		Aiea	HI	☐
Oshiro	The Honorable Blake	Hawaii State Legislature	Honolulu	HI	☐
Pine	The Honorable Kymberly	Hawaii State Legislature	Honolulu	HI	☐
Pine	The Honorable Kymberly	Hawaii State Legislature, Public Safety & Military Affairs	Honolulu	HI	☐
Pool	Polly		Kaneohe	HI	☐
Pratt	James		Honolulu	HI	☐
Rabideau	Robert A.	FAA Honolulu Control Facility	Honolulu	HI	☑
Recktenwald	Mark	Department of Commerce and Consumer Affairs	Honolulu	HI	☐
Rhoads	The Honorable Karl	Hawaii State Legislature	Honolulu	HI	☐
Robinson	William	National Oceanic and Atmospheric Admin National Marine Fisheries Services	Honolulu	HI	☐
Rosen	Liane	Naval Facilities Engineering Command, Pacific	Pearl Harbor	HI	☐
Saiki	The Honorable Scott	Hawaii State Legislature	Honolulu	HI	☐
Sakamoto	The Honorable Norman	Hawaii State Legislature	Honolulu	HI	☐
Say	The Honorable Calvin	Hawaii State Legislature	Honolulu	HI	☐
Schlapak	Ben	Honolulu International Airport	Honolulu	HI	☑
Shida	Keith	Board of Water Supply	Honolulu	HI	☑
Slom	The Honorable Sam	Hawaii State Legislature	Honolulu	HI	☐
Sonson	The Honorable Alex	Hawaii State Legislature	Honolulu	HI	☐

LAST NAME	FIRST NAME	COMPANY	CITY	STATE	PROVIDED DRAFT EA COMMENTS
Sonson	The Honorable Alex	Hawaii State Legislature, Public Safety & Military Affairs	Honolulu	HI	☐
Souki	The Honorable Joseph	Hawaii State Legislature, Public Safety & Military Affairs	Honolulu	HI	☐
Sunada	Kelvin	Department of Health, Environmental Planning Office	Honolulu	HI	☑
Takai	The Honorable Mark	Hawaii State Legislature	Honolulu	HI	☐
Takamine	The Honorable Dwight	Hawaii State Legislature, Public Safety & Military Affairs	Honolulu	HI	☐
Takumi	The Honorable Roy	Hawaii State Legislature	Honolulu	HI	☐
Takumi	The Honorable Roy	Hawaii State Legislature, Public Safety & Military Affairs	Honolulu	HI	☐
Taniguchi	The Honorable Brian	Hawaii State Legislature	Honolulu	HI	☐
Trimble	The Honorable Gordon	Hawaii State Legislature	Honolulu	HI	☐
Tsutsui	The Honorable Shan	Hawaii State Legislature, Intergovernmental and Military Affairs	Honolulu	HI	☐
Wakai	The Honorable Glenn	Hawaii State Legislature	Honolulu	HI	☐
Ward, PhD	The Honorable Gene	Hawaii State Legislature	Honolulu	HI	☐
White	Iwalani D.	Department of Public Safety	Honolulu	HI	☐
Wong	Steve	Federal Aviation Administration	Honolulu	HI	☐
Wong	Darryll	HQ HIANG/CS	Honolulu	HI	☐
Yamane	The Honorable Ryan	Hawaii State Legislature	Honolulu	HI	☐
Yokota	C.K.	Department of the Navy	Pearl Harbor	HI	☑
Young	Peter	Department of Land and Natural Resources	Honolulu	HI	☑
Young	George	Department of the Army	Ft. Shafter	HI	☑

Section 106 Consultation

LINDA LINGLE
GOVERNOR OF HAWAII

ALLAN A. SMITH
INTERIM CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

KEN C. KAWAHARA
DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCE

STATE HISTORIC PRESERVATION DIVISION
601 KAMOKILA BOULEVARD, ROOM 555
KAPOLEI, HAWAII 96707

July 23, 2007

Mr. Ronnie D. Lanier
Chief, Environmental Flight
15 CES Environmental Planning Office
US Air Force, 15 Airlift Wing
Hickam AFB, Hawaii 96853

LOG NO: 2007.2482
DOC NO: 0707BF08
Architecture
Archaeology

Dear Mr. Lanier:

SUBJECT: Section 106 Review
RE: Demolition of Buildings 3379, 3385, 3402, 3404, 3422, 3426, 3431, 3434, 3435, 3400A, 3425 and Renovation of Buildings 3415, 3416, 11666, 3020, 3041, 3042, 3044, 3386, 3407 and 3424
Project Location: Hickam Force Base (AFB) Island of Oahu
TMK: 9-9-001:13

This is in response to your letter dated July 13, 2007, which we received on July 16, 2007.

Hickam Air Force Base is to become a beddown of the F-22 fighter jet. To meet the needs of the beddown area, the Air Force proposes construction of seven (7) new facilities, alteration or renovation of ten (10) facilities and demolition of eleven (11) facilities. These proposed changes will allow the 154th Wing to meet the changing aircraft mission.

The buildings slated for demolition are: 3379, 3385, 3402, 3404, 3422, 3426, 3431, 3434, 3435, 3400A, 3425. These buildings were built between 1961 and 1989 with the exception of Building 3425, which was built in 1995. Building 3425 is considered non-historic. Building 3400A is a 1961 metal hanger with adjoining masonry support office building and adjoining this facility is 3400B, a masonry support facility built in 1961 as a medical facility and now currently a support facility. Building 3400B will not be demolished or altered as part of this undertaking.

These buildings are slated for renovation or alteration: 3415, 3416, 11666, 3020, 3041, 3042, 3044, 3386, 3407 and 3424. Buildings 3020, 3041, 3042, 3044, 3386, 3407 and 3424 are considered non-historic due to the dates of construction between 1991 and 1997. Buildings 3415, 3416, 11666 were built between 1963 and 1989.

Due to the extensive nature and scope of the project, a site visit was conducted on June 21, 2007 with Mr. Gary O'Donnell, AIA, Chief of Environmental Planning and Base Historic Preservation Officer; Mr. Bryan Flower, Architecture Branch Chief of the State Historic Preservation Division; and Captain Ian Beltran of the 154th Wing. During the site visit, it was determined the buildings slated for demolition do not meet National Register criteria for eligibility, particularly criteria A and C. The buildings were also evaluated for their significance for association with the Cold War. Only Building 3400 appeared to meet Cold War significance. Further research by the Air Force indicated the facility was used for the Hawaii Guard and no major Cold War events are associated with the facility.

Within the project APE, there are two National Register resources; Battery Selfridge (Building 3440) and Battery Jackson (Battery 3418). These are costal defense batteries listed on the National Register of Historic Places in 1984. These batteries are not included in the proposed project, and no direct impact is expected from the project. The visual impacts to the battery will not adversely affect the historic nature or National Register significance.

As stated in the provided documents, numerous fishponds, including Loko Waiahao (SIHP No. 50-80-13-94) and Loko Ke'oki (SIHP No. 50-80-13-95), are located in the vicinity of the area of potential effect (APE). We believe that an adverse impact on these and other unknown subsurface deposits may be mitigated through archaeological monitoring. We concur with your recommendation for archaeological monitoring during all ground activities associated with this undertaking. Therefore, as long as the proposed undertaking is implemented with monitoring of all ground disturbing activities, then we believe that the proposed undertaking will have *no adverse effect on historic properties*. We look forward to receiving, and reviewing, the archaeological monitoring plan prior to construction activities.

The State Historic Preservation Division concurs with the Air Force's determination of *no adverse affect to historic resources*. Should you have any questions regarding this request, please call Bryan Flower at our Oahu office at (808) 692-8027.

Sincerely,

for Allan A. Smith
State Historic Preservation Officer

BF:

Appendix D
Airspace Management

APPENDIX D AIRSPACE MANAGEMENT

Controlled Airspace is defined in Federal Aviation Administration (FAA) Order 7400.2. It is airspace of defined dimensions within which Air Traffic Control (ATC) service is provided to Instrument Flight Rule (IFR) flights and to Visual Flight Rule (VFR) flights in accordance with the airspace classification. For IFR operations in controlled airspace, a pilot must file an IFR flight plan and receive an appropriate ATC clearance.

Controlled airspace in the United States is designated as Class A, B, C, D, and E. Each Class B, C, and D airspace designated for an airport contains at least one primary airport around which the airspace is designated.

Class A airspace, generally, is that airspace from 18,000 feet above mean sea level (MSL) up to and including Flight Level (FL) 600. Flight levels are altitudes MSL based on the use of a directed barometric altimeter setting, and are expressed in hundreds-of-feet. Therefore, FL 600 is equal to approximately 60,000 feet MSL. Class A airspace includes the airspace overlying the waters within 12 nautical miles (NM) of the coast of the 48 contiguous states and Alaska (DOT 2001).

Class B airspace, generally, is that airspace from the surface to 10,000 feet MSL around the nation's busiest airports. The actual configuration of Class B airspace is individually tailored and consists of a surface area and two or more layers, and is designed to contain all published instrument procedures (DOT 2001).

Class C airspace, generally, is that airspace from the surface to 4,000 feet above the airport elevation (charted in MSL) surrounding those airports that have an operational control tower, are serviced by a radar approach control (RAPCON), and that have a certain number of IFR operations or passenger enplanements. Although the actual configuration of Class C airspace is individually tailored, it usually consists of a surface area with a 5-NM radius, and an outer circle with a 10-NM radius that extends from 1,200 feet to 4,000 feet above the airport elevation (DOT 2001).

Class D airspace, generally, is that airspace from the surface to 2,500 feet above the airport elevation (charted in MSL) surrounding those airports that have an operational control tower. The configuration of each Class D airspace area is individually tailored and when instrument procedures are published, the airspace will normally be designed to contain the procedures. Arrival extensions for instrument approach procedures may be designated as Class D or Class E airspace (DOT 2001).

Class E airspace is controlled airspace that is not Class A, B, C, or D. There are seven types of Class E airspace, as described below.

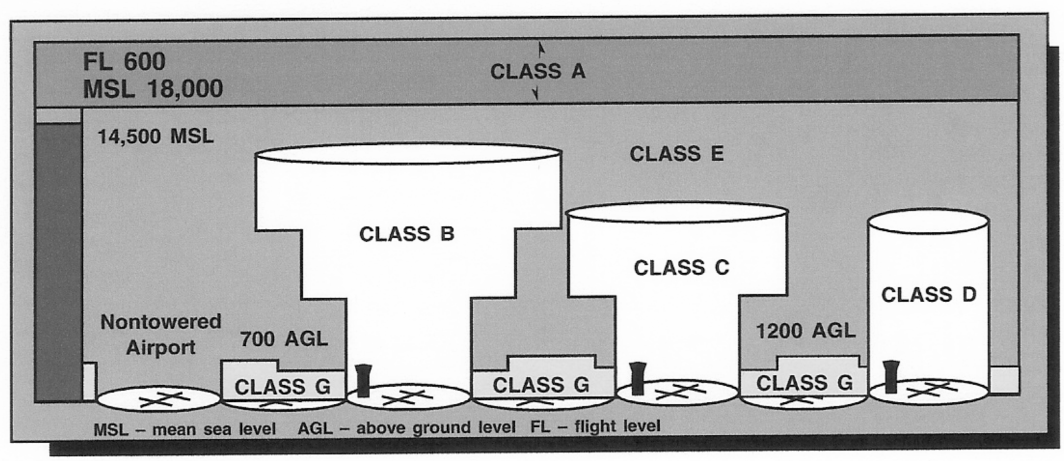
- **Surface Area Designated For An Airport.** When so designated, the airspace will be configured to contain all instrument procedures.
- **Extension To A Surface Area.** There are Class E airspace areas that serve as extensions to Class B, C, and D surface areas designated for an airport. This airspace provides controlled airspace to contain standard instrument approach procedures without imposing a communications requirement on pilots operating under VFR.

- **Airspace Used For Transition.** There are Class E airspace areas beginning at either 700 or 1,200 feet above ground level (AGL) used to transition to/from the terminal or en route environment.
- **En Route Domestic Airspace Areas.** These areas are Class E airspace areas that extend upward from a specified altitude to provide controlled airspace where there is a requirement for IFR en route ATC services, but where the Federal airway system is inadequate.
- **Federal Airways.** Federal Airways (Victor Routes) are Class E airspace areas, and, unless otherwise specified, extend upward from 1,200 feet to, but not including, 18,000 feet MSL.
- **Other.** Unless designated at a lower altitude, Class E airspace begins at 14,500 feet MSL to, but not including 18,000 feet MSL overlying: a) the 48 contiguous states, including the waters within 12 miles from the coast of the 48 contiguous states; b) the District of Columbia; c) Alaska, including the waters within 12 miles from the coast of Alaska, and that airspace above FL 600; d) excluding the Alaska peninsula west of 160°00'00" west longitude, and the airspace below 1,500 feet above the surface of the earth unless specifically so designated.
- **Offshore/Control Airspace Areas.** This includes airspace areas beyond 12 NM from the coast of the United States, wherein ATC services are provided (DOT 2001).

Airspace that has not been designated as Class A, B, C, D, or E airspace is **Uncontrolled Airspace (Class G)** (DOT 2001).

These airspaces are shown graphically in Figure 1.

Figure 1. Controlled / Uncontrolled Airspace



Source: DOT 2003

Airspace for Special Use (ASU) is used to collectively identify non-SUA assets. It is of defined dimensions wherein activities must be confined because of their nature, and/or wherein limitations may be imposed upon aircraft operations that are not a part of those activities. ASU includes Military Training Routes (MTRs) (Instrument Routes [IR]/Visual Routes [VR]), Air Traffic Control Assigned Airspace (ATCAA), aerial refueling track/anchors (AR), slow routes (SR), and low-altitude tactical navigation areas.

Special Use Airspace (SUA) is airspace of defined dimensions identified by an area on the surface of the earth wherein activities must be confined because of their nature and/or wherein limitations may be imposed upon aircraft operations that are not part of those activities. Types of SUA include Alert Areas, Controlled Firing Areas, MOAs, Prohibited Areas, Restricted Areas, and Warning Areas. All F-15 and projected F-22A training occurs in offshore Warning Areas.

Warning Area is airspace of defined dimensions extending from 3 nautical miles outward from the coast of the United States, that contains activity that may be hazardous to nonparticipating aircraft. The purpose of such warning area is to warn nonparticipating pilots of the potential danger. A warning area may be located over domestic or international waters or both (P/CG 2006).

Air Traffic Control Assigned Airspace (ATCAA) is airspace of defined vertical and lateral limits, assigned by ATC, for the purpose of providing air traffic segregation between the specified activities being conducted within the assigned airspace and other IFR air traffic. This airspace, if not required for other purposes, may be made available for military use. ATCAAs are frequently structured and used to extend the horizontal and/or vertical boundaries of MOAs.

Military Operations Area (MOA) is airspace of defined vertical and lateral limits established outside Class A airspace to separate and segregate certain non-hazardous military activities from IFR traffic and to identify for VFR traffic where these activities are conducted (P/CG 2004). Class A airspace covers the continental U.S. and limited parts of Alaska, including the airspace overlying the water within 12 NM of the U.S. coast. It extends from 18,000 feet MSL up to and including 60,000 feet MSL (P/CG 2004). MOAs are considered "joint use" airspace. Hickam-based F-22A aircraft would only use MOAs when they were deployed to the Continental United States (CONUS) or Alaska locations. Non-participating aircraft operating under VFR are permitted to enter a MOA, even when the MOA is active for military use. Aircraft operating under IFR must remain clear of an active MOA unless approved by the responsible ARTCC. Flight by both participating and VFR non-participating aircraft is conducted under the "see-and-avoid" concept, which stipulates that "when weather conditions permit, pilots operating IFR or VFR are required to observe and maneuver to avoid other aircraft. Right-of-way rules are contained in CFR Part 91" (P/CG 2004). The responsible ARTCC provides separation service for aircraft operating under IFR and MOA participants. The "see-and-avoid" procedures mean that if a MOA were active during inclement weather, the general aviation pilot could not safely access the MOA airspace.

Restricted Area is designated airspace that supports ground or flight activities that could be hazardous to non-participating aircraft. A Restricted Area is airspace designated under 14 Code of Federal Regulations (CFR) Part 73, within which the flight of aircraft, while not wholly prohibited, is subject to restriction. Most restricted areas are designated "joint-use" and IFR/VFR operations in the area may be authorized by the controlling ATC facility when it is not being utilized by the using agency (P/CG 2004). Hawaii has Restricted Areas, but the current F-15s and the proposed F-22As would not use these airspaces.

Military Training Routes (MTRs) are flight corridors developed and used by the DoD to practice high-speed, low-altitude flight, generally below 10,000 feet MSL. Specifically, MTRs are airspace of defined vertical and lateral dimensions established for the conduct of military flight training at airspeeds in excess of 250 knots indicated airspeed (KIAS) (P/CG 2004). MTRs are developed in accordance with criteria specified in FAA Order 7610.4 (DoD 2004). They are described by a centerline (often with defined horizontal limits on either side of the centerline) and vertical limits expressed as minimum and maximum altitudes along the flight track. MTRs are identified as Visual Routes (VR) or Instrument Routes (IR). Hawaii has MTRs, but the current F-15s and the proposed F-22As would not use these airspaces.

VRs and IRs are used by DoD and associated Reserve and Air Guard units for the purpose of conducting low-altitude navigation and tactical training. VRs are under VFR conditions (usually below 10,000 feet MSL) at airspeeds in excess of 250 KIAS (P/CG 2004). IRs are used by DoD, including associated Reserve and Air Guard units, for the purpose of conducting low-altitude navigation and tactical training in both IFR and VFR weather conditions usually below 10,000 feet MSL at airspeeds in excess of 250 KIAS (P/CG 2004).

References

U.S. Department of Transportation (DOT), Federal Aviation Administration (FAA). 2006. Aeronautical Information Manual, February 16, 2006. Headquarters Air Combat Command (ACC) Page 12, Supplement 1 to Air Force Instruction 13-201, Air Force Airspace Management, 24 June 1999.

U.S. Department of Transportation (DOT), Federal Aviation Administration (FAA). 2003. FAA-H-8083-25, Pilot's Handbook of Aeronautical Knowledge.

U.S. Department of Transportation (DOT), Federal Aviation Administration (FAA). 2001. FAA Order 7400.2E, Procedures For Handling Airspace Matters. June 4.

Appendix E
Aircraft Noise Analysis

APPENDIX E AIRCRAFT NOISE ANALYSIS

Noise is generally described as unwanted sound. Unwanted sound can be based on objective effects (such as hearing loss or damage to structures) or subjective judgments (community annoyance). Noise analysis thus requires a combination of physical measurement of sound, physical and physiological effects, plus psycho- and socio-acoustic effects.

Section 1.0 of this appendix describes how sound is measured and summarizes noise impact in terms of community acceptability and land use compatibility. Section 2.0 gives detailed descriptions of the effects of noise that lead to the impact guidelines presented in section 1. Section 3.0 provides a description of the specific methods used to predict aircraft noise, including a detailed description of sonic booms.

1.0 NOISE DESCRIPTORS AND IMPACT

F-15 and proposed F-22A aircraft operating in the airspace generate two types of sound. One is "subsonic" noise, which is continuous sound generated by the aircraft's engines and also by air flowing over the aircraft itself. The other is sonic booms, which are transient impulsive sounds generated during supersonic flight. These two types of sound are quantified in different ways.

Section 1.1 describes the characteristics that are used to describe sound. Section 1.2 describes the specific noise metrics used for noise impact analysis. Section 1.3 describes how environmental impact and land use compatibility are judged in terms of these quantities.

1.1 Quantifying Sound

Measurement and perception of sound involve two basic physical characteristics: amplitude and frequency. Amplitude is a measure of the strength of the sound and is directly measured in terms of the pressure of a sound wave. Because sound pressure varies in time, various types of pressure averages are usually used. Frequency, commonly perceived as pitch, is the number of times per second the sound causes air molecules to oscillate. Frequency is measured in units of cycles per second, or hertz (Hz).

Amplitude. The loudest sounds the human ear can comfortably hear have acoustic energy one trillion times the acoustic energy of sounds the ear can barely detect. Because of this vast range, attempts to represent sound amplitude by pressure are generally unwieldy. Sound is therefore usually represented on a logarithmic scale with a unit called the decibel (dB). Sound on the decibel scale is referred to as a sound level. The minimum threshold of human hearing is approximately 0 dB, and the threshold of discomfort or pain is around 120 dB.

Because of the logarithmic nature of the decibel scale, sounds levels do not add and subtract directly and are somewhat cumbersome to handle mathematically. However, some simple rules of thumb are useful in dealing with sound levels. First, if a sound's intensity is doubled, the sound level increases by 3 dB, regardless of the initial sound level. Thus, for example:

60 dB + 60 dB = 63 dB, and

80 dB + 80 dB = 83 dB.

The total sound level produced by two sounds of different levels is usually only slightly more than the higher of the two. For example:

60.0 dB + 70.0 dB = 70.4 dB.

Because the addition of sound levels behaves differently than that of ordinary numbers, such addition is often referred to as "decibel addition" or "energy addition." The latter term arises from the fact that combination of decibel values consists of first converting each decibel value to its corresponding acoustic energy, then adding the energies using the normal rules of addition, and finally converting the total energy back to its decibel equivalent.

The difference in dB between two sounds represents the ratio of the amplitudes of those two sounds. Because human senses tend to be proportional (i.e., detect whether one sound is twice as big as another) rather than absolute (i.e., detect whether one sound is a given number of pressure units bigger than another), the decibel scale correlates well with human response.

Under laboratory conditions, differences in sound level of 1 dB can be detected by the human ear. In the community, the smallest change in average noise level that can be detected is about 3 dB. A change in sound level of about 10 dB is usually perceived by the average person as a doubling (or halving) of the sound's loudness, and this relation holds true for loud sounds and for quieter sounds. A decrease in sound level of 10 dB actually represents a 90 percent decrease in sound *intensity* but only a 50 percent decrease in perceived *loudness* because of the nonlinear response of the human ear (similar to most human senses).

The one exception to the exclusive use of levels to quantify sound, rather than physical pressure units, is in the case of sonic booms. As described in Section 3, sonic booms are coherent waves with specific characteristics. There is a long-standing tradition of describing individual sonic booms by the amplitude of the shock waves, in pounds per square foot (psf). This is particularly relevant when assessing structural effects as opposed to loudness or cumulative community response. In this study, sonic booms are quantified by either dB or psf, as appropriate for the particular impact being assessed.

Frequency. The normal human ear can hear frequencies from about 20 Hz to about 20,000 Hz. It is most sensitive to sounds in the 1,000 to 4,000 Hz range. When measuring community response to noise, it is common to adjust the frequency content of the measured sound to correspond to the frequency sensitivity of the human ear. This adjustment is called A-weighting (American National Standards Institute 1988). Sound levels that have been so adjusted are referred to as A-weighted sound levels.

The audible quality of high-thrust engines in modern military combat aircraft can be somewhat different than other aircraft, including (at high throttle settings) the characteristic nonlinear crackle of high thrust engines. The spectral characteristics of various noises are accounted for by A-weighting, which approximates the response of the human ear but does not necessarily account for quality. There are other, more detailed, weighting factors that have been applied to sounds. In the 1950s and 1960s, when noise from civilian jet aircraft became an issue, substantial research was performed to determine what characteristics of jet noise were a problem. The metrics Perceived Noise Level and Effective Perceived Noise Level were developed. These accounted for nonlinear behavior of hearing and the importance of low frequencies at high levels, and for many years airport/airbase noise contours were presented in terms of Noise Exposure Forecast, which was based on Perceived Noise Level and Effective Perceived Noise Level. In the 1970s, however, it was realized that the primary intrusive aspect of aircraft noise was the high noise level, a factor which is well represented by A-weighted levels and DNL. The refinement of Perceived Noise Level, Effective Perceived Noise Level, and Noise Exposure Forecast was not significant in protecting the public from noise.

There has been continuing research on noise metrics and the importance of sound quality, sponsored by the Department of Defense (DoD) for military aircraft noise and by the Federal Aviation Administration (FAA) for civil aircraft noise. The metric L_{dnmr}, which is described later and accounts for the increased annoyance of rapid onset rate of sound, is a product of this long-term research.

The amplitude of A-weighted sound levels is measured in dB. It is common for some noise analysts to denote the unit of A-weighted sounds by dBA. As long as the use of A-weighting is understood, there is no difference between dB or dBA: it is only important that the use of A-weighting be made clear. In this Environmental Assessment (EA), sound levels are reported in dB.

A-weighting is appropriate for continuous sounds, which are perceived by the ear. Impulsive sounds, such as sonic booms, are perceived by more than just the ear. When experienced indoors, there can be secondary noise from rattling of the building. Vibrations may also be felt. C-weighting (American National Standards Institute 1988) is applied to such sounds. This is a frequency weighting that is flat over the range of human hearing (about 20 Hz to 20,000 Hz) and rolls off above and below that range. In this study, C-weighted sound levels are used for the assessment of sonic booms and other impulsive sounds. As with A-weighting, the unit is dB, but dBC is sometimes used for clarity. In this study, sound levels are reported in dB, and C-weighting is specified as necessary.

Time Averaging. Sound pressure of a continuous sound varies greatly with time, so it is customary to deal with sound levels that represent averages over time. Levels presented as instantaneous (i.e., as might be read from the display of a sound level meter) are based on averages of sound energy over either 1/8 second (fast) or 1 second (slow). The formal definitions of fast and slow levels are somewhat complex, with details that are important to the makers and users of instrumentation. They may, however, be thought of as levels corresponding to the root-mean-square sound pressure measured over the 1/8-second or 1-second periods.

The most common uses of the fast or slow sound level in environmental analysis is in the discussion of the maximum sound level that occurs from the action, and in discussions of typical sound levels. Figure 1 is a chart of A-weighted sound levels from typical sounds. Some (air conditioner, vacuum cleaner) are continuous sounds whose levels are constant for some time. Some (automobile, heavy truck) are the maximum sound during a vehicle passby. Some (urban daytime, urban nighttime) are averages over some extended period. A variety of noise metrics have been developed to describe noise over different time periods. These are described in section 1.2.

1.2 Noise Metrics

Maximum Sound Level

The highest A-weighted sound level measured during a single event in which the sound level changes value as time goes on (e.g., an aircraft overflight) is called the maximum A-weighted sound level or maximum sound level, for short. It is usually abbreviated by ALM, L_{max}, or L_{Amax}. The maximum sound level is important in judging the interference caused by a noise event with conversation, TV or radio listening, sleeping, or other common activities. Table 1 reflects L_{max} values for typical aircraft associated with this assessment operating at the indicated flight profiles and power settings.

Table 1. Representative Maximum Sound Levels (L_{MAX})[1]

Aircraft Type	*Airspeed (Knots)*	*Power Setting[2]*	L_{MAX} Values (in dBA) at Varying Distances (in Feet)				
			500	*1,000*	*2,000*	*5,000*	*10,000*
F-15	520	81% NC	114	107	99	86	74
F-22A	520	70% ETR	116	108	99	85	71
F-18A	500	92% NC	116	108	99	85	71
B-1B	550	101% RPM	112	106	98	86	75

Notes: 1. Level flight, steady high-speed conditions.
2. The type of engine and aircraft determines the power setting: RPM = rotations per minute, NC = percent core RPM, and ETR = engine temperature ratio.

Peak Sound Level

For impulsive sounds, the true instantaneous sound pressure is of interest. For sonic booms, this is the peak pressure of the shock wave, as described in section 3.2 of this appendix. This pressure is usually presented in physical units of pounds per square foot. Sometimes it is represented on the decibel scale, with symbol L_{pk}. Peak sound levels do not use either A or C weighting.

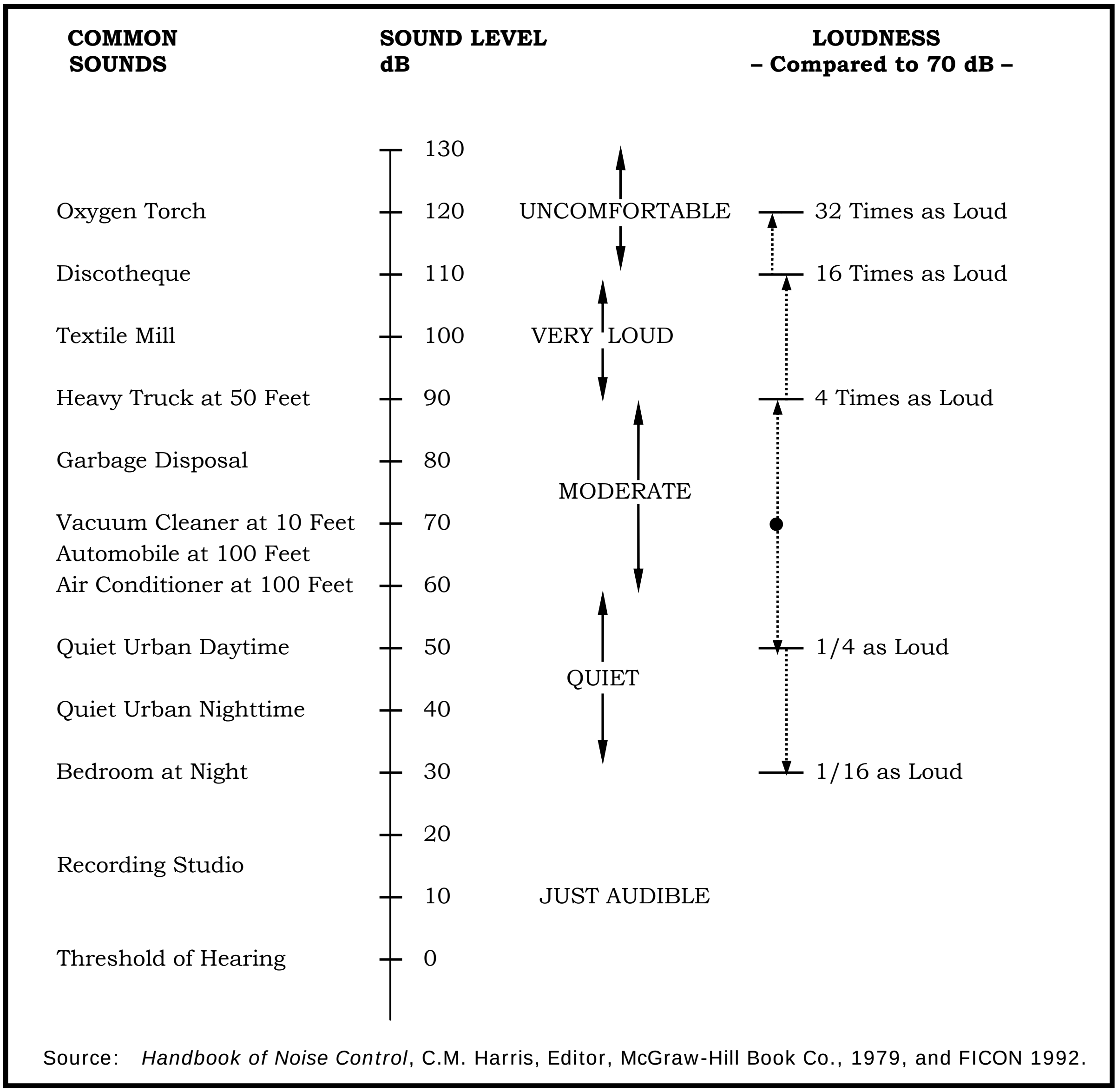


Figure 1. Typical A-Weighted Sound Levels of Common Sounds

Sound Exposure Level

Individual time-varying noise events have two main characteristics: a sound level that changes throughout the event and a period of time during which the event is heard. Although the maximum sound level, described above, provides some measure of the intrusiveness of the event, it alone does not completely describe the total event. The period of time during which the sound is heard is also significant. The Sound Exposure Level (abbreviated SEL or L_{AE} for A-weighted sounds) combines both of these characteristics into a single metric.

SEL is a composite metric that represents both the intensity of a sound and its duration. Mathematically, the mean square sound pressure is computed over the duration of the event, then multiplied by the duration in seconds, and the resultant product is turned into a sound level. It does not directly represent the sound level heard at any given time, but rather provides a measure of the net impact of the entire acoustic event. It has been well established in the scientific community that SEL measures this impact much more reliably than just the maximum sound level. Table 2 shows SEL values corresponding to the aircraft and power settings reflected in Table 1.

Table 2. Representative Sound Exposure Levels[1]

Aircraft Type	*Airspeed (Knots)*	SEL Values (in dBA) at Varying Distances (in Feet)				
		500	*1,000*	*2,000*	*5,000*	*10,000*
F-15	520	112	107	101	91	80
F-22A	520	114	108	101	89	77
F-18A	500	114	108	101	89	77
B-1B	550	112	107	101	92	82

Notes: 1. Level flight, steady high-speed conditions.

Because the SEL and the maximum sound level are both used to describe single events, there is sometimes confusion between the two, so the specific metric used should be clearly stated.

SEL can be computed for C-weighted levels (appropriate for impulsive sounds), and the results denoted CSEL or L_{CE}. SEL for A-weighted sound is sometimes denoted ASEL. Within this study, SEL is used for A-weighted sounds and CSEL for C-weighted.

Equivalent Sound Level

For longer periods of time, total sound is represented by the equivalent continuous sound pressure level (L_{eq}). L_{eq} is the average sound level over some time period (often an hour or a day, but any explicit time span can be specified), with the averaging being done on the same energy basis as used for SEL. SEL and L_{eq} are closely related, with L_{eq} being SEL over some time period normalized by that time.

Just as SEL has proven to be a good measure of the noise impact of a single event, L_{eq} has been established to be a good measure of the impact of a series of events during a given time period. Also, while L_{eq} is defined as an average, it is effectively a sum over that time period and is, thus, a measure of the cumulative impact of noise.

Day-Night Average Sound Level

Noise tends to be more intrusive at night than during the day. This effect is accounted for by applying a 10-dB penalty to events that occur after 10 p.m. and before 7 a.m. If L_{eq} is computed over a 24-hour period with this nighttime penalty applied, the result is the day-night average sound level (DNL). DNL is the community noise metric recommended by the United States Environmental Protection Agency (USEPA) (1974) and has been adopted by most federal agencies (Federal Interagency Committee on Noise 1992). It has been well established that DNL correlates well with community response to noise (Schultz 1978; Finegold *et al.* 1994). This correlation is presented in Section 1.3 of this appendix.

While DNL carries the nomenclature "average," it incorporates all of the noise at a given location. For this reason, DNL is often referred to as a "cumulative" metric. It accounts for the total, or cumulative, noise impact.

It was noted earlier that, for impulsive sounds, such as sonic booms, C-weighting is more appropriate than A-weighting. The day-night average sound level can be computed for C-weighted noise and is denoted CDNL or L_{Cdn}. This procedure has been standardized, and impact interpretive criteria similar to those for DNL have been developed (Committee on Hearing, Bioacoustics and Biomechanics 1981).

Onset-Adjusted Monthly Day-Night Average Sound Level

Aircraft operations in military training airspace generate a noise environment somewhat different from other community noise environments. Overflights are sporadic, occurring at random times and varying from day to day and week to week. This situation differs from most community noise environments, in which noise tends to be continuous or patterned. Individual military overflight events also differ from typical community noise events in that noise from a low-altitude, high-airspeed flyover can have a rather sudden onset.

To represent these differences, the conventional DNL metric is adjusted to account for the "surprise" effect of the sudden onset of aircraft noise events on humans (Plotkin *et al.* 1987; Stusnick *et al.* 1992; Stusnick *et al.* 1993). For aircraft exhibiting a rate of increase in sound level (called onset rate) of from 15 to 150 dB per second, an adjustment or penalty ranging from 0 to 11 dB is added to the normal SEL. Onset rates above 150 dB per second require an 11 dB penalty, while onset rates below 15 dB per second require no adjustment. The DNL is then determined in the same manner as for conventional aircraft noise events and is designated as Onset-Rate Adjusted Day-Night Average Sound Level (abbreviated L_{dnmr}). Because of the irregular occurrences of aircraft operations, the number of average daily operations is determined by using the calendar month with the highest number of operations. The monthly average is denoted L_{dnmr}. Noise levels are calculated the same way for both DNL and L_{dnmr}. L_{dnmr} is interpreted by the same criteria as used for DNL.

1.3 Noise Impact

Community Reaction

Studies of community annoyance to numerous types of environmental noise show that DNL correlates well with impact. Schultz (1978) showed a consistent relationship between DNL and annoyance. Shultz's original curve fit (Figure 2) shows that there is a remarkable consistency in results of attitudinal surveys that relate the percentages of groups of people who express various degrees of annoyance when exposed to different DNL.

A more recent study has reaffirmed this relationship (Fidell *et al.* 1991). Figure 3 (Federal Interagency Committee on Noise 1992) shows an updated form of the curve fit (Finegold *et al.* 1994) in comparison with the original. The updated fit, which does not differ substantially from the original, is the current preferred form. In general, correlation coefficients of 0.85 to 0.95 are found between the percentages of groups of people highly annoyed and the level of average noise exposure. The correlation coefficients for the annoyance of individuals are relatively low, however, on the order of 0.5 or less. This is not surprising, considering the varying personal factors that influence the manner in which individuals react to noise. Nevertheless, findings substantiate that community annoyance to aircraft noise is represented quite reliably using DNL.

As noted earlier for SEL, DNL does not represent the sound level heard at any particular time, but rather represents the total sound exposure. DNL accounts for the sound level of individual noise events, the duration of those events, and the number of events. Its use is endorsed by the scientific community (American National Standards Institute 1980, 1988; USEPA 1974; Federal Interagency Committee on Urban Noise 1980; Federal Interagency Committee on Noise 1992).

While DNL is the best metric for quantitatively assessing cumulative noise impact, it does not lend itself to intuitive interpretation by non-experts. Accordingly, it is common for environmental noise analyses to include other metrics for illustrative purposes. A general indication of the noise environment can be presented by noting the maximum sound levels that can occur and the number of times per day noise events will be loud enough to be heard. Use of other metrics as supplements to DNL has been endorsed by federal agencies (Federal Interagency Committee on Noise 1992).

The Schultz curve is generally applied to annual average DNL. In Section 1.2, L_{dnmr} was described and presented as being appropriate for quantifying noise in military airspace. In the current study, the Schultz curve is used with L_{dnmr} as the noise metric. L_{dnmr} is always equal to or greater than DNL, so impact is generally higher than would have been predicted if the onset rate and busiest-month adjustments were not accounted for.

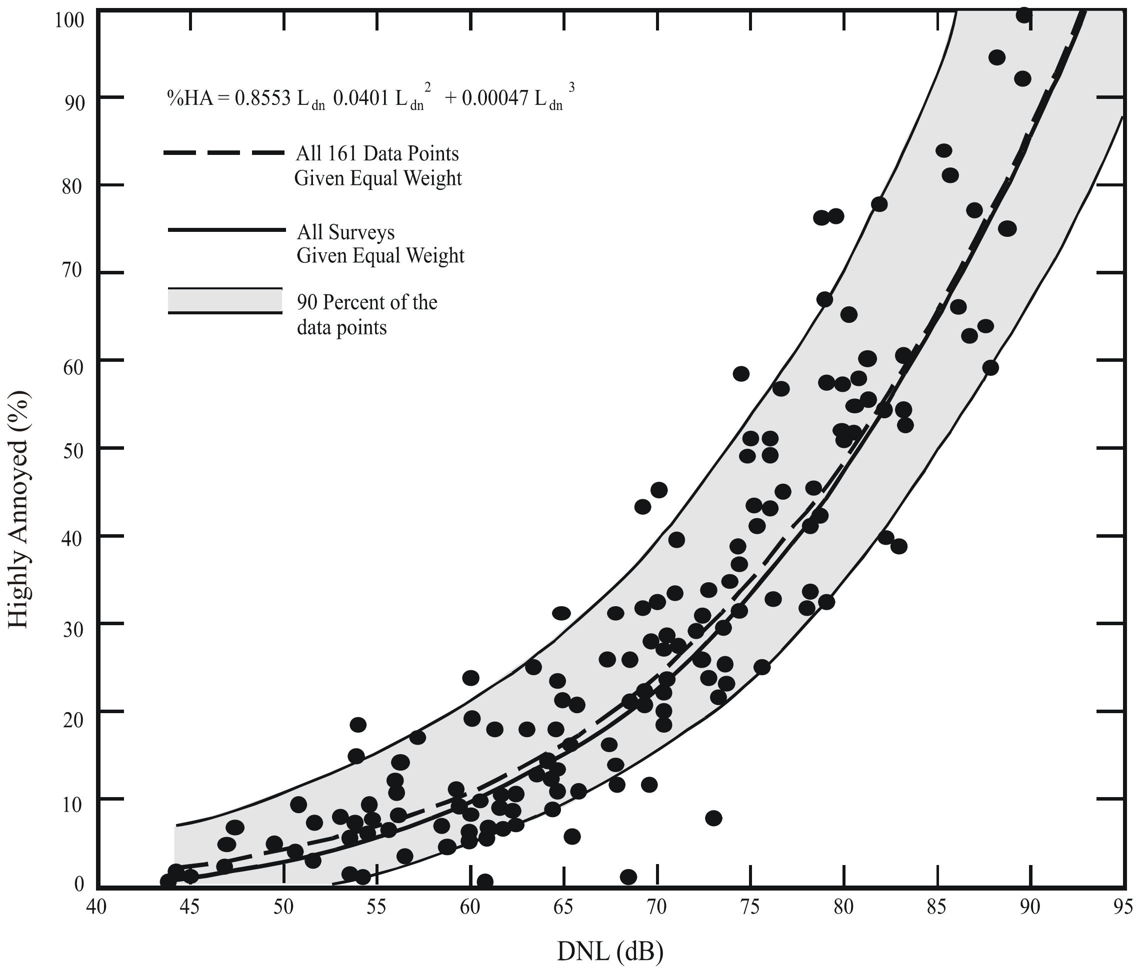
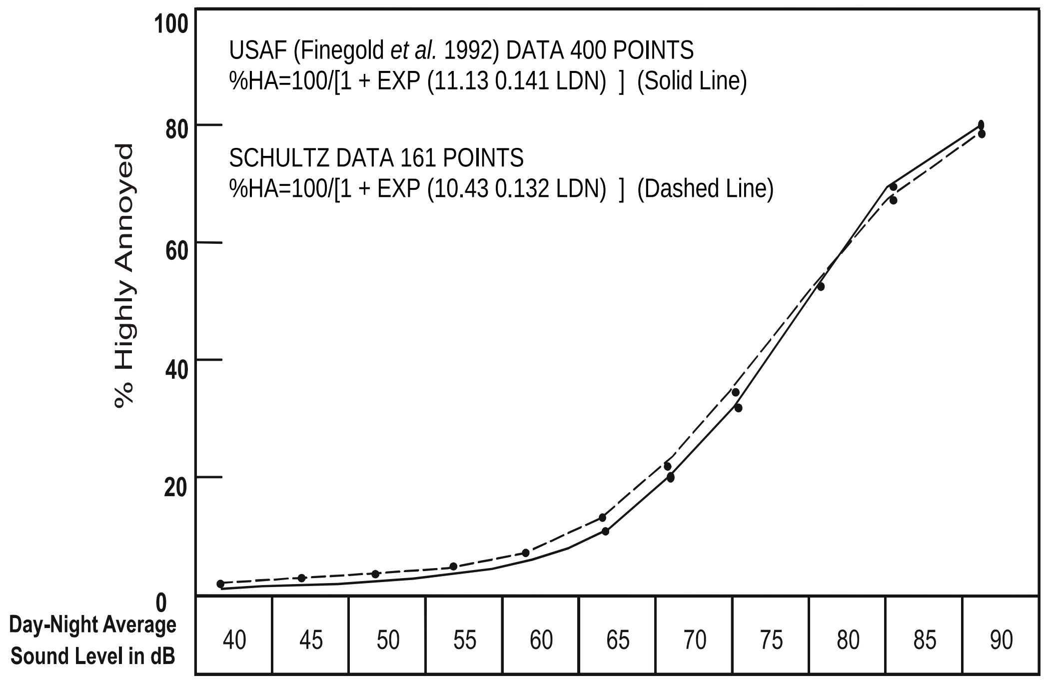


Figure 2. Community Surveys of Noise Annoyance (Source: Schultz 1978)



Calculated %HA Points	40	45	50	55	60	65	70	75	80	85	90
USAF	0.41	0.831	1.66	3.31	6.48	12.29	22.1	36.47	53.74	70.16	82.64
SCHULTZ	0.576	1.11	2.12	4.03	7.52	13.59	23.32	37.05	53.25	68.78	81

Figure 3. Response of Communities to Noise; Comparison of Original (Schultz 1978) and Current (Finegold et al. 1994) Curve Fits.

There are several points of interest in the noise-annoyance relation. The first is DNL of 65 dB. This is a level most commonly used for noise planning purposes and represents a compromise between community impact and the need for activities like aviation which do cause noise. Areas exposed to DNL above 65 dB are generally not considered suitable for residential use. The second is DNL of 55 dB, which was identified by USEPA as a level "...requisite to protect the public health and welfare with an adequate margin of safety" (USEPA 1974), which is essentially a level below which adverse impact is not expected. The third is DNL of 75 dB. This is the lowest level at which adverse health effects could be credible (USEPA 1974). The very high annoyance levels correlated with DNL of 75 dB make such areas unsuitable for residential land use.

Sonic boom exposure is measured by C-weighting, with the corresponding cumulative metric being CDNL. Correlation between CDNL and annoyance has been established, based on community reaction to impulsive sounds (Committee on Hearing, Bioacoustics and Biomechanics 1981). Values of the C-weighted equivalent to the Schultz curve are different than that of the Schultz curve itself. Table 3 shows the relation between annoyance, DNL, and CDNL.

Table 3. Relation Between Annoyance, DNL and CDNL

DNL	*% Highly Annoyed*	*CDNL*
45	0.83	42
50	1.66	46
55	3.31	51
60	6.48	56
65	12.29	60
70	22.10	65

Interpretation of CDNL from impulsive noise is accomplished by using the CDNL versus annoyance values in Table 1. CDNL can be interpreted in terms of an "equivalent annoyance" DNL. For example, CDNL of 52, 61, and 69 dB are equivalent to DNL of 55, 65, and 75 dB, respectively. If both continuous and impulsive noise occurs in the same area, impacts are assessed separately for each.

Land Use Compatibility

As noted above, the inherent variability between individuals makes it impossible to predict accurately how any individual will react to a given noise event. Nevertheless, when a community is considered as a whole, its overall reaction to noise can be represented with a high degree of confidence. As described above, the best noise exposure metric for this correlation is the DNL or L_{dnmr} for military overflights. Impulsive noise can be assessed by relating CDNL to an "equivalent annoyance" DNL, as outlined in Section 1.3.1.

In June 1980, an ad hoc Federal Interagency Committee on Urban Noise published guidelines (1980) relating DNL to compatible land uses. This committee was composed of representatives from DoD, Transportation, and Housing and Urban Development; USEPA; and the Veterans

Administration. Since the issuance of these guidelines, federal agencies have generally adopted these guidelines for their noise analyses.

Following the lead of the committee, DoD and FAA adopted the concept of land-use compatibility as the accepted measure of aircraft noise effect. The FAA included the committee's guidelines in the Federal Aviation Regulations (United States Department of Transportation 1984). These guidelines are reprinted in Table 4, along with the explanatory notes included in the regulation. Although these guidelines are not mandatory (note the footnote "*" in the table), they provide the best means for determining noise impact in airport communities. In general, residential land uses normally are not compatible with outdoor DNL values above 65 dB, and the extent of land areas and populations exposed to DNL of 65 dB and higher provides the best means for assessing the noise impacts of alternative aircraft actions. In some cases a change in noise level, rather than an absolute threshold, may be a more appropriate measure of impact.

2.0 NOISE EFFECTS

The discussion in Section 1.3 presents the global effect of noise on communities. The following sections describe particular noise effects.

2.1 Hearing Loss

Noise-induced hearing loss is probably the best defined of the potential effects of human exposure to excessive noise. Federal workplace standards for protection from hearing loss allow a time-average level of 90 dB over an 8-hour work period, or 85 dB averaged over a 16-hour period. Even the most protective criterion (no measurable hearing loss for the most sensitive portion of the population at the ear's most sensitive frequency, 4,000 Hz, after a 40-year exposure) suggests a time-average sound level of 70 dB over a 24-hour period (USEPA 1974). Since it is unlikely that airport neighbors will remain outside their homes 24 hours per day for extended periods of time, there is little possibility of hearing loss below a DNL of 75 dB, and this level is extremely conservative.

2.2 Nonauditory Health Effects

Nonauditory health effects of long-term noise exposure, where noise may act as a risk factor, have not been found to occur at levels below those protective against noise-induced hearing loss, described above. Most studies attempting to clarify such health effects have found that noise exposure levels established for hearing protection will also protect against any potential nonauditory health effects, at least in workplace conditions. The best scientific summary of these findings is contained in the lead paper at the National Institutes of Health Conference on Noise and Hearing Loss, held on January 22–24, 1990, in Washington, D.C., which states "The nonauditory effects of chronic noise exposure, when noise is suspected to act as one of the risk factors in the development of hypertension, cardiovascular disease, and other nervous disorders, have never been proven to occur as chronic manifestations at levels below these criteria (an average of 75 dBA for complete protection against hearing loss for an eight-hour day)" (von Gierke 1990; parenthetical wording added for clarification). At the International Congress (1988) on Noise as a Public Health Problem, most studies attempting to clarify such health effects did not find them at levels below the criteria protective of noise-induced hearing loss; and even above these criteria, results regarding such health effects were ambiguous.

Table 4. Land-Use Compatibility With Yearly Day-Night Average Sound Levels

Land Use	Yearly Day-Night Average Sound Level (DNL) in Decibels					
	Below 65	**65–70**	**70–75**	**75–80**	**80–85**	**Over 85**
Residential						
Residential, other than mobile homes and transient lodgings	Y	N(1)	N(1)	N	N	N
Mobile home parks	Y	N	N	N	N	N
Transient lodgings	Y	N(1)	N(1)	N(1)	N	N
Public Use						
Schools	Y	N(1)	N(1)	N	N	N
Hospitals and nursing homes	Y	25	30	N	N	N
Churches, auditoria, and concert halls	Y	25	30	N	N	N
Government services	Y	Y	25	30	N	N
Transportation	Y	Y	Y(2)	Y(3)	Y(4)	Y(4)
Parking	Y	Y	Y(2)	Y(3)	Y(4)	N
Commercial Use						
Offices, business and professional	Y	Y	25	30	N	N
Wholesale and retail—building materials, hardware, and farm equipment	Y	Y	Y(2)	Y(3)	Y(4)	N
Retail trade—general	Y	Y	25	30	N	N
Utilities	Y	Y	Y(2)	Y(3)	Y(4)	N
Communication	Y	Y	25	30	N	N
Manufacturing and Production						
Manufacturing, general	Y	Y	Y(2)	Y(3)	Y(4)	N
Photographic and optical	Y	Y	25	30	N	N
Agriculture (except livestock) and forestry	Y	Y(6)	Y(7)	Y(8)	Y(8)	Y(8)
Livestock farming and breeding	Y	Y(6)	Y(7)	N	N	N
Mining and fishing, resource production and extraction	Y	Y	Y	Y	Y	Y
Recreational						
Outdoor sports arenas and spectator sports	Y	Y(5)	Y(5)	N	N	N
Outdoor music shells, amphitheaters	Y	N	N	N	N	N
Nature exhibits and zoos	Y	Y	N	N	N	N
Amusements, parks, resorts, and camps	Y	Y	Y	N	N	N
Golf courses, riding stables, and water recreation	Y	Y	25	30	N	N

Numbers in parentheses refer to notes.

* The designations contained in this table do not constitute a federal determination that any use of land covered by the program is acceptable or unacceptable under federal, state, or local law. The responsibility for determining the acceptable and permissible land uses and the relationship between specific properties and specific noise contours rests with the local authorities. FAA determinations under Part 150 are not intended to substitute federally determined land uses for those determined to be appropriate by local authorities in response to locally determined needs and values in achieving noise-compatible land uses.

KEY TO TABLE 4

Y (YES) = Land Use and related structures compatible without restrictions.
N (No) = Land Use and related structures are not compatible and should be prohibited.
NLR = Noise Level Reduction (outdoor to indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure.
25, 30, or 35 = Land Use and related structures generally compatible; measures to achieve NLR of 25, 30, or 35 dB must be incorporated into design and construction of structures.

NOTES FOR TABLE 4

(1) Where the community determines that residential or school uses must be allowed, measures to achieve outdoor-to-indoor Noise Level Reduction (NLR) of at least 25 dB and 30 dB should be incorporated into building codes and be considered in individual approvals. Normal residential construction can be expected to provide an NLR of 20 dB; thus the reduction requirements are often stated as 5, 10, or 15 dB over standard construction and normally assume mechanical ventilation and closed windows year-round. However, the use of NLR criteria will not eliminate outdoor noise problems.
(2) Measures to achieve NLR 25 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise-sensitive areas, or where the normal noise level is low.
(3) Measures to achieve NLR 30 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise-sensitive areas, or where the normal noise level is low.
(4) Measures to achieve NLR 35 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise-sensitive areas, or where the normal noise level is low.
(5) Land-use compatible provided special sound reinforcement systems are installed.
(6) Residential buildings require an NLR of 25.
(7) Residential buildings require an NLR of 30.
(8) Residential buildings not permitted.

Consequently, it can be concluded that establishing and enforcing exposure levels protecting against noise-induced hearing loss would not only solve the noise-induced hearing loss problem but also any potential nonauditory health effects in the work place.

Although these findings were directed specifically at noise effects in the work place, they are equally applicable to aircraft noise effects in the community environment. Research studies regarding the nonauditory health effects of aircraft noise are ambiguous, at best, and often contradictory. Yet, even those studies that purport to find such health effects use time-average noise levels of 75 dB and higher for their research.

For example, in an often-quoted paper, two University of California at Los Angeles researchers found a relation between aircraft noise levels under the approach path to Los Angeles International Airport and increased mortality rates among the exposed residents by using an average noise exposure level greater than 75 dB for the "noise-exposed" population (Meecham and Shaw 1979). Nevertheless, three other University of California at Los Angeles professors analyzed those same data and found no relation between noise exposure and mortality rates (Frerichs *et al*. 1980).

As a second example, two other University of California at Los Angeles researchers used this same population near Los Angeles International Airport to show a higher rate of birth defects during the period of 1970 to 1972 when compared with a control group residing away from the airport (Jones and Tauscher 1978). Based on this report, a separate group at the United States Centers for Disease Control performed a more thorough study of populations near Atlanta's Hartsfield International Airport for 1970 to 1972 and found no relation in their study of 17 identified categories of birth defects to aircraft noise levels above 65 dB (Edmonds 1979).

A recent review of health effects, prepared by a Committee of the Health Council of The Netherlands (Committee of the Health Council of the Netherlands 1996), analyzed currently available published information on this topic. The committee concluded that the threshold for possible long-term health effects was a 16-hour (6:00 a.m. to 10:00 p.m.) L_{eq} of 70 dB. Projecting this to 24 hours and applying the 10-dB nighttime penalty used with DNL, this corresponds to DNL of about 75 dB. The study also affirmed the risk threshold for hearing loss, as discussed earlier.

In summary, there is no scientific basis for a claim that potential health effects exist for aircraft time-average sound levels below 75 dB.

2.3 Annoyance

The primary effect of aircraft noise on exposed communities is one of annoyance. Noise annoyance is defined by the USEPA as any negative subjective reaction on the part of an individual or group (USEPA 1974). As noted in the discussion of DNL above, community annoyance is best measured by that metric.

Because the USEPA Levels Document (USEPA 1974) identified DNL of 55 dB as ". . . requisite to protect public health and welfare with an adequate margin of safety," it is commonly assumed that 55 dB should be adopted as a criterion for community noise analysis. From a noise exposure perspective, that would be an ideal selection. However, financial and technical resources are generally not available to achieve that goal. Most agencies have identified DNL of 65 dB as a criterion that protects those most impacted by noise, and that can often be achieved on a practical basis (Federal Interagency Committee on Noise 1992). This corresponds to about 12 percent of the exposed population being highly annoyed.

Although DNL of 65 dB is widely used as a benchmark for significant noise impact, and is often an acceptable compromise, it is not a statutory limit, and it is appropriate to consider other thresholds in particular cases.

In this EA, no specific threshold is used. The noise in the affected environment is evaluated on the basis of the information presented in this appendix and in the body of the EA.

Community annoyance from sonic booms is based on CDNL, as discussed in Section 1.3. These effects are implicitly included in the "equivalent annoyance" CDNL values in Table 1, since those were developed from actual community noise impact.

2.4 Speech Interference

Speech interference associated with aircraft noise is a primary cause of annoyance to individuals on the ground. The disruption of routine activities in the home, such as radio or television listening, telephone use, or family conversation, gives rise to frustration and irritation. The quality of speech communication is also important in classrooms, offices, and industrial settings and can cause fatigue and vocal strain in those who attempt to communicate over the noise. Research has shown that the use of the SEL metric will measure speech interference successfully, and that a SEL exceeding 65 dB will begin to interfere with speech communication.

2.5 Sleep Interference

Sleep interference is another source of annoyance associated with aircraft noise. This is especially true because of the intermittent nature and content of aircraft noise, which is more disturbing than continuous noise of equal energy and neutral meaning.

Sleep interference may be measured in either of two ways. "Arousal" represents actual awakening from sleep, while a change in "sleep stage" represents a shift from one of four sleep stages to another stage of lighter sleep without actual awakening. In general, arousal requires a somewhat higher noise level than does a change in sleep stage.

An analysis sponsored by the Air Force summarized 21 published studies concerning the effects of noise on sleep (Pearsons *et al*. 1989). The analysis concluded that a lack of reliable in-home studies, combined with large differences among the results from the various laboratory studies, did not permit development of an acceptably accurate assessment procedure. The noise events used in the laboratory studies and in contrived in-home studies were presented at much higher rates of occurrence than would normally be experienced. None of the laboratory studies were of sufficiently long duration to determine any effects of habituation, such as that which would occur under normal community conditions. A recent extensive study of sleep interference in people's own homes (Ollerhead 1992) showed very little disturbance from aircraft noise.

There is some controversy associated with the recent studies, so a conservative approach should be taken in judging sleep interference. Based on older data, the USEPA identified an indoor DNL of 45 dB as necessary to protect against sleep interference (USEPA 1974). Assuming a very conservative structural noise insulation of 20 dB for typical dwelling units, this corresponds to an outdoor DNL of 65 dB as minimizing sleep interference.

A 1984 publication reviewed the probability of arousal or behavioral awakening in terms of SEL (Kryter 1984). Figure 4, extracted from Figure 10.37 of Kryter (1984), indicates that an indoor SEL of 65 dB or lower should awaken less than 5 percent of those exposed. These results do not include any habituation over time by sleeping subjects. Nevertheless, this provides a reasonable guideline for assessing sleep interference and corresponds to similar guidance for speech interference, as noted above.

2.6 Noise Effects on Marine Mammals

All marine mammals are protected from injury and harassment under the Marine Mammal Protection Act (MMPA). Mammals specified in the law as marine mammals include cetaceans (whales, dolphins, porpoises), pinnipeds (seals, sea lions), and species not associated with Hawaiian waters including walrus, sirenians (manatees and dugongs), sea otters, and polar bears. Certain species are additionally protected by the Endangered Species Act (ESA), including sperm whales, manatees, many of the baleen whales, and certain pinnipeds. The MMPA specifically forbids such harassment of marine mammals as interference with feeding, breeding, or breathing.

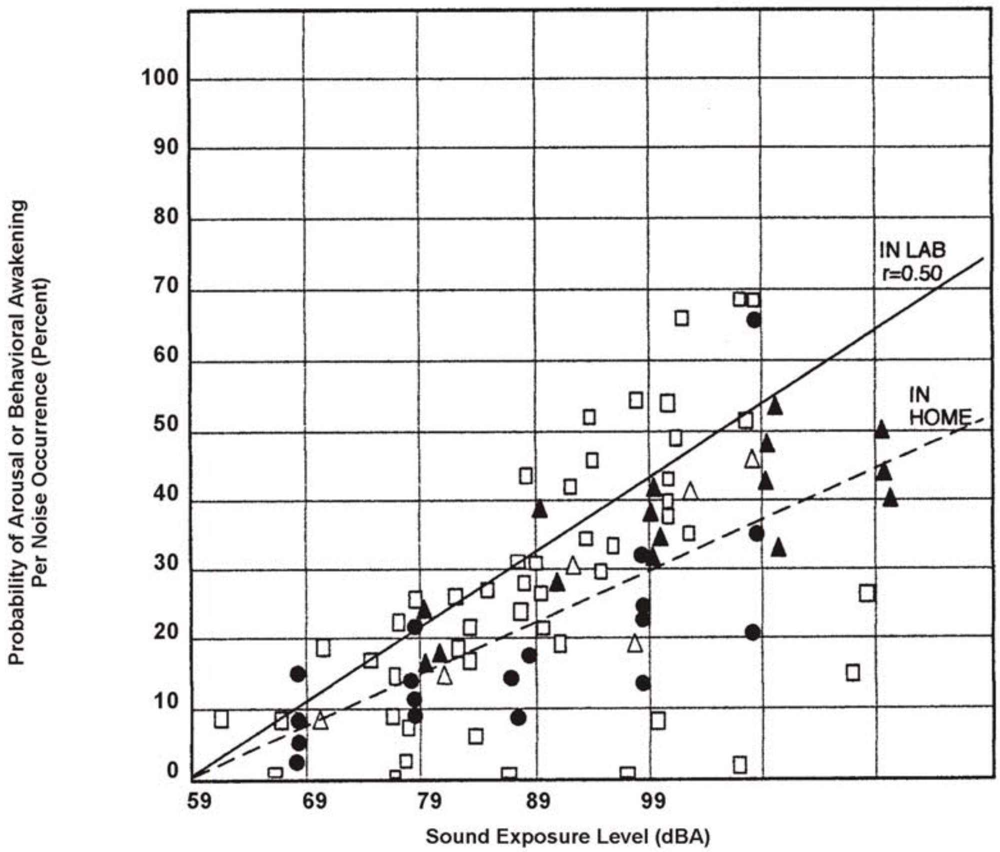
Subsonic Noise

The impact of man-made noise on marine mammals in water is a high-visibility and controversial topic among both scientists and environmental planners. Special attention from the regulators and the public has been given to seismic exploration sources, Navy sonars, and explosives. Impact from aircraft noise in water has been studied to a limited extent, and the MMPA/ESA risk is generally insignificant, as discussed below.

Marine mammal hearing capabilities vary greatly among species. This can be very important in assessing risk from noise, especially aircraft noise.

Hearing tests have been performed on only a few species of the smaller marine mammals, usually in captivity: certain dolphins, seals, sea lions, and manatees. Hearing capabilities of other marine mammals are estimated from anatomy of the ear and from at-sea observations vocalizations and reactions to sound. Although knowledge of marine mammal hearing is generally poor, it is not unusual in risk assessments to find marine mammals classified according to high and low hearing bands:

> Class H: Those that have most sensitive hearing above 1,000 Hz, and poor hearing below 1,000 Hz. These include all toothed whales (odontocetes) except for sperm whales, which occur in both classes, most pinnipeds (seals and sea lions), and sirenians (manatees). Best hearing for small odontocetes is generally in the range from about 10 kilohertz (kHz) to 80 kHz, and measurements show very poor hearing below about 200 Hz.



LEGEND

- □ Laboratory Studies, Variety of Noises, Lukas
- ● Steady State (In Home)
- ▲ Transient (In Home)
- △ Truck Noise, Laboratory Study, Thiesen
  Transformer, Transmission Line, Window Air Conditioner, and Distant Traffic Noise, Horonjeff

FIGURE 4. PROBABILITY OF AROUSAL OR BEHAVIORAL AWAKENING IN TERMS OF SOUND EXPOSURE LEVEL

Class L: Those that have sensitive hearing below 1,000 Hz. These include all baleen whales (mysticetes), the sperm whale, California sea lions, and elephant seals. Vocalizations of the baleen and sperm whales suggest hearing capabilities as low as 10 Hz, but hearing capabilities above 1,000 Hz are not known. A limit of 25 kHz is sometimes used.

Note that the band of human hearing straddles these bands, with best responses from about 20 Hz to 10 kHz. Noise from the F-22 flying at subsonic speeds is continuous in nature, meaning that it is persistent in time (non-impulsive). As such, the metrics, criteria, and potential for impact on marine mammals is quite different from those for impulsive noise. The metric of choice is the intensity level (or rms pressure level or SPL), sometimes with exposure time as a parameter.

Precedents for compliance actions show a wide range of opinion as to what noise properties may harass or injure animals (under the MMPA). Levels for physical injury from continuous signals are usually linked to permanent threshold shift (PTS). Typical conditions for Level B harassment are as follows:

> For continuous noise of order seconds in duration and in the band of hearing of the animal, behavioral harassment (Level B for MMPA) may occur for sound pressure levels in excess of 180 dB (re 1 μPa). Longer exposures to aircraft noise may require a decrease in the threshold to levels as low as 175 dB. This applies to all marine mammals. This is approximately the approach used in various Navy "LWAD" environmental assessments, and as approved by the regulator (NOAA/NMFS). The levels are extrapolated from Schlundt *et al* (2000) and from Richardson *et al*. (1995).

Note that other examples can be given with higher thresholds (e.g., temporary threshold shift [TTS] for tactical sonar signals) or lower thresholds (e.g., low-frequency active sonars).

Radiated noise for subsonic flight is nearly omni directional in nature. There will generally be pressure waves incident on the water surface at angles steeper than the critical angle of 13 degrees, as well as arrivals at less steep angles. The pressure doubles at the surface, propagates for the steep arrivals, and decays with depth for the less steep arrivals. For certain ocean conditions, the propagating energy may travel significant distances with low loss intensity. For this reason, a loitering airplane or helicopter may be more worrisome than a supersonic aircraft. The reference section lists a number of published papers on the topic of subsonic aircraft noise in water.

As for military, fixed-wing aircraft traveling at subsonic speeds, noise source levels are generally less than 210 dB (re 1 μPa at 1 m). For typical flight conditions and an altitude of 1,000 feet, the maximum sound pressure level at the sea surface would be no greater than about 155 dB (re 1 μPa), which is well below most harassment thresholds in current use.

Sonic Booms

Sonic boom noise in air and in water is generally treated as "impulsive noise," meaning that the sound has short duration, a sharp onset or rise-time, and broad frequency content. Other noise sources treated as impulsive by the regulators include airguns, explosives, and sparkers. Recent precedent for criteria and thresholds for injury and harassment under MMPA have been calculated. Table 5 below provides some relevant examples of thresholds used in recent compliance work. In the table, decibel quantities for energy flux density are referenced to 1 μPa^2-s, where the energy flux density (EFD) is the integral over the signal duration of the squared pressure, normalized by impedance.

Table 5. Examples of NMFS Harassment Noise Criteria and Thresholds

Criterion	*Threshold*	*Reference*
Level B Harassment TTS	Maximum EFD level over all 1/3-octave bands above 100 Hz > 182 dB for mammals in Class H	SEAWOLF Shock Trial FEIS and NMFS Final Rule (1998)
Level B Harassment TTS	Maximum EFD level over all 1/3-octave bands above 10 Hz > 182 dB for mammals in Class L	SEAWOLF Shock Trial FEIS and NMFS Final Rule (1998)
Injury -Eardrum Rupture	EFD in excess of 1.2 psi-in (205 dB)	SEAWOLF Shock Trial FEIS (1998)
Injury -PTS	RMS pressure level exceeds 190 dB (re 1 μPa)	HESS committee, as discussed at NMFS criteria workshop (1998)

Here, TTS and PTS are degradations in hearing, sometimes treated by regulators as harassment criteria for mammals under the MMPA and ESA.

Propagation of sound from air to water is a complicated topic, and very important for risk estimation. It is discussed in a number of acoustics books (e.g., Brekhovskikh and Lysanov 1981). The most important features are summarized as follows:

> Because of the large mismatch of impedances between air and water (a factor of about 3,500), there exists a "critical angle" of about 13 degrees, measured from the vertical, at the air-sea interface.

For a pressure wave arriving at the interface at angles steeper than 13 degrees, the wave is transmitted into the water and propagates at a shallower angle (as determined by Snell's law) in the water. The pressure in the water at the interface is double the incident pressure, and falls off according to propagation conditions in the water column. During training, F-22A sonic boom events can occur during level flight or maneuvers associated with simulated combat or defensive maneuvers.

For energy incident from air on the sea surface at angles less steep than about 13 degrees, there is no transmission of energy as a propagating wave into the water. Instead, there is only an evanescent wave, or non-propagating wave, whose amplitude decays exponentially with depth in the water. As before, there is a doubling of pressure at the interface, but the impact is limited to a region close to the surface and point of incidence. The wave does not propagate on its own in water, but is "bound" to the pressure field in the air. It thus appears to travel horizontally at the velocity of the aircraft (and is thus subsonic in water for F-22A aircraft speeds.

The evanescent decay rate with depth is about (8.7) $2\pi\ \gamma$ dB per wavelength where $\gamma = [(c_2/c_1)^2\sin^2\theta_1 - 1]^{1/2}$ with c the speed of sound, θ the incidence angle measured from the vertical, and indices 1 for air and 2 for water. See Table 6 for examples of estimates of depth dependence of the evanescent wave from an F-22 sonic boom.

Table 6. Estimates of Depth Dependence of Pressure and Energy for Evanescent Wave from F-22 Sonic Boom

Mach #	*Altitude*	*Peak at 0 meters*	*Peak at 50 meters*	*Peak at 100 meters*	*EFD at 0 meters*	*EFD at 50 meters*	*EFD at 100 meters*
1.5	1 km	178	143	132	162	136	127
1.5	5 km	166	137	126	152	130	121
1.5	10 km	160	134	123	146	126	118
2.5	1 km	180	154	143	163	144	136
2.5	5 km	167	147	136	152	137	129
2.5	10 km	161	142	132	146	132	125

Note: 'Peak' is peak pressure level in dB re 1 μPa and 'EFD' is energy flux density level is dB re 1 μPa^2-s. For reference, a peak pressure of 1 psi = 197 dB and 1 psf is 175 dB.

Note also that the differences in impedance between air and water mean that even though the pressure is about the same on either side of the interface, the intensity (and energy) of the wave are much greater in air than in water (about 31 dB). This is reflected in the thresholds for injury and harassment. Whereas a short-duration signal of level 140 dB (re 1 μPa) [or 114 dB (re 20 μPa)] in air could be harmful to mammal hearing, 140 dB (re 1 μPa) in water is usually considered quite safe for animals and humans.

Sonic Boom Noise Effects on Marine Mammals

An aircraft in level flight at M times the speed of sound in air produces a shock wave at the "Mach angle" (arcsin [1/M], relative to the aircraft line of flight). M is the "Mach number" and Mach 1 is of order 300 m/s at sea level. The shock wave travels at the speed of sound in air on a path perpendicular to the shock cone, and thus arrives at the air-sea interface with the Mach angle as incidence angle (measured from the vertical). As M increases above 1, the Mach angel decreases, and the angle of incidence with the water becomes steeper. For M = 1.01, the angle is 82 degrees, for M = 2, it is 30 degrees, and for M = 4.3 it is 13 degrees. From the propagation discussion above, notice that it is very important that sonic boom energy from the F-22 (and all military aircraft of record) will arrive at the air-sea interface at an angle less steep than critical, and will not be transmitted into the water as a propagating wave. This is generally true for most airplane maneuvers, most weather conditions, and most sea states.

The basic physics of penetration of sonic booms into water was established by Cook (1970) and Sawyers (1968) during supersonic transport (SST) research. There has been renewed interest in the topic over the past few years by the National Aeronautics and Space Administration (NASA). See the papers of Sparrow and Rochat during the 1990s, the other papers in the bibliography, and the measurements of Sohn and others (2000). Numerical models and measured data support the original Cook/Sawyers work, although the issue of penetration for high Mach numbers and high sea states is still of some interest.

The strongest conceivable sonic boom generated during air combat training is less than 30 psf. In that case, the pressure of the surface would be about 0.2 psi, or about 183 dB (re 1 μPa). For a typical sonic boom N wave, the energy level in the greatest one-third octave band above 10 Hz would be about 158 dB (re 1 μPa^2-s). Both values are well below the impulse-noise thresholds for harassment and indicate the lack of impact on marine mammals of all types.

The above analysis is for level flight. During combat training, aircraft are often diving while at supersonic speeds. Diving increases the incidence angle of the boom on the surface, increasing the efficiency of penetration into the water. However, the margins between level flight incidence angle and the penetration angle, and between worst case pressures and the threshold of impact are so large that no impact is expected.

3.0 NOISE MODELING

3.1 *Subsonic Aircraft Noise*

An aircraft in subsonic flight generally emits noise from two sources: the engines and flow noise around the airframe. Noise generation mechanisms are complex and, in practical models, the noise sources must be based on measured data. The Air Force has developed a series of computer models and aircraft noise databases for this purpose. The models include NOISEMAP (Moulton 1992) for noise around airbases, and MR_NMAP (Lucas and Calamia 1996) for use in MOAs, ranges, and low-level training routes. These models use the NOISEFILE database developed by the Air Force. NOISEFILE data includes SEL and L_{Amax} as a function of speed and power setting for aircraft in straight flight.

Noise from an individual aircraft is a time-varying continuous sound. It is first audible as the aircraft approaches, increases to a maximum when the aircraft is near its closest point, then diminishes as it departs. The noise depends on the speed and power setting of the aircraft and its trajectory. The models noted above divide the trajectory into segments whose noise can be computed from the data in NOISEFILE. The contributions from these segments are summed.

MR_NMAP was used to compute noise levels in the airspace. The primary noise metric computed by MR_NMAP was L_{dnmr} averaged over each airspace. Supporting routines from NOISEMAP were used to calculate SEL and L_{Amax} for various flight altitudes and lateral offsets from a ground receiver position.

3.2 Sonic Booms

When an aircraft moves through the air, it pushes the air out of its way. At subsonic speeds, the displaced air forms a pressure wave that disperses rapidly. At supersonic speeds, the aircraft is moving too quickly for the wave to disperse, so it remains as a coherent wave. This wave is a sonic boom. When heard at the ground, a sonic boom consists of two shock waves (one associated with the forward part of the aircraft, the other with the rear part) of approximately equal strength and (for fighter aircraft) separated by 100 to 200 milliseconds. When plotted, this pair of shock waves and the expanding flow between them have the appearance of a capital letter "N," so a sonic boom pressure wave is usually called an "N-wave." An N-wave has a characteristic "bang-bang" sound that can be startling. Figure 5 shows the generation and evolution of a sonic boom N-wave under the aircraft. Figure 6 shows the sonic boom pattern for an aircraft in steady supersonic flight. The boom forms a cone that is said to sweep out a "carpet" under the flight track.

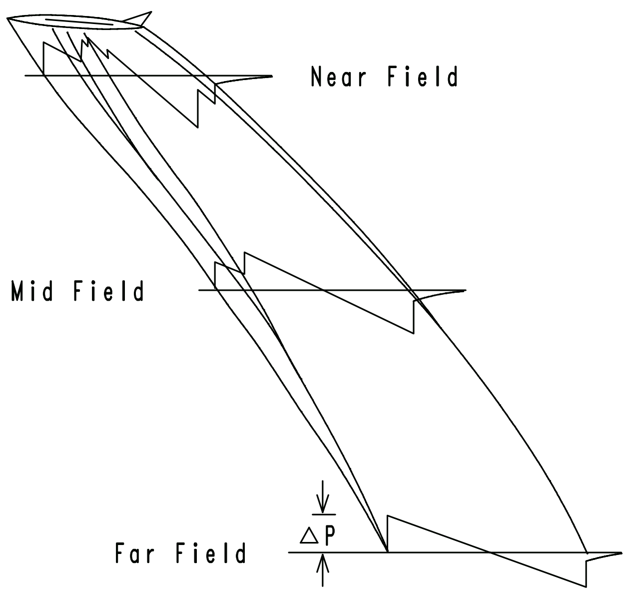


Figure 5. Sonic Boom Generation and Evolution to N-wave

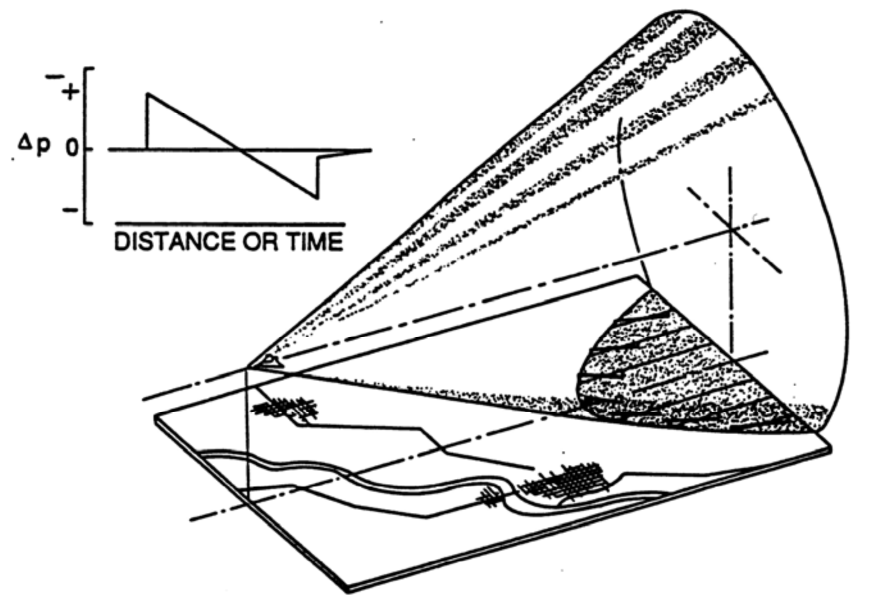


Figure 6. Sonic Boom Carpet in Steady Flight

The complete ground pattern of a sonic boom depends on the size, shape, speed, and trajectory of the aircraft. Even for a nominally steady mission, the aircraft must accelerate to supersonic speed at the start, decelerate back to subsonic speed at the end, and usually change altitude. Figure 7 illustrates the complexity of a nominal full mission.

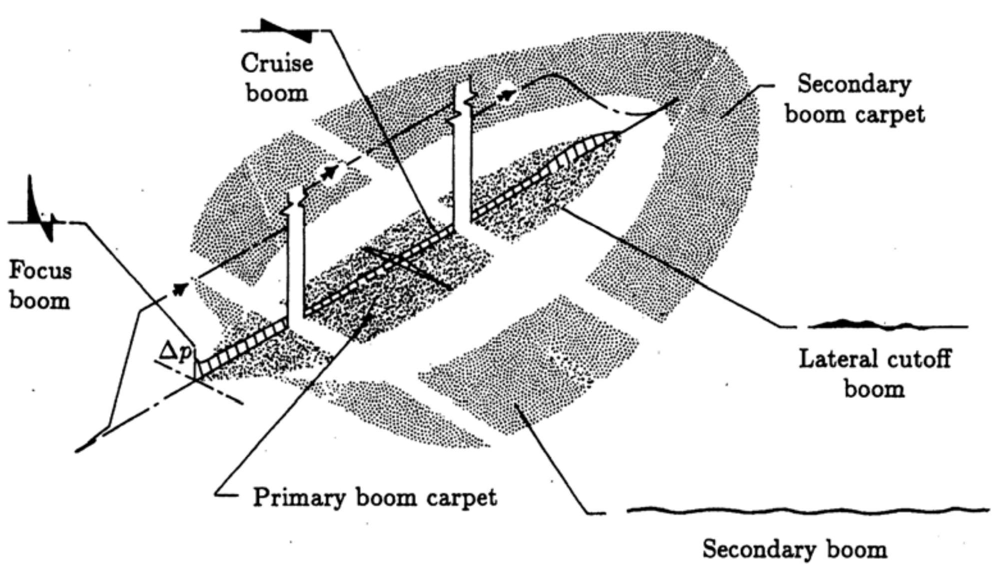


Figure 7. Complex Sonic Boom Pattern for Full Mission

The Air Force's PCBoom4 computer program (Plotkin and Grandi 2002) can be used to compute the complete sonic boom footprint for a given single event, accounting for details of a particular maneuver.

Supersonic operations for the proposed action and alternatives are, however, associated with air combat training, which cannot be described in the deterministic manner that PCBoom4 requires. Supersonic events occur as aircraft approach an engagement, break at the end, and maneuver for advantage during the engagement. Long time cumulative sonic boom exposure, CDNL, is meaningful for this kind of environment.

Long-term sonic boom measurement projects have been conducted in four supersonic air combat training airspaces: White Sands, New Mexico (Plotkin *et al.* 1989); the eastern portion of the Goldwater Range, Arizona (Plotkin *et al.* 1992); the Elgin MOA at Nellis AFB, Nevada (Frampton *et al.* 1993); and the western portion of the Goldwater Range (Page *et al.* 1994). These studies included analysis of schedule and air combat maneuvering instrumentation data and supported development of the 1992 BOOMAP model (Plotkin *et al.* 1992). The current version of BOOMAP (Frampton *et al.* 1993; Plotkin 1996) incorporates results from all four studies. Because BOOMAP is directly based on long-term measurements, it implicitly accounts for such variables as maneuvers, statistical variations in operations, atmosphere effects, and other factors.

Figure 8 shows a sample of supersonic flight tracks measured in the air combat training airspace at White Sands (Plotkin *et al.* 1989). The tracks fall into an elliptical pattern aligned with preferred engagement directions in the airspace. Figure 9 shows the CDNL contours that were fit to six months of measured booms in that airspace. The subsequent measurement programs refined the fit, and demonstrated that the elliptical maneuver area is related to the size and shape of the airspace (Frampton *et al*. 1993). BOOMAP quantifies the size and shape of CDNL contours, and also numbers of booms per day, in air combat training airspaces.

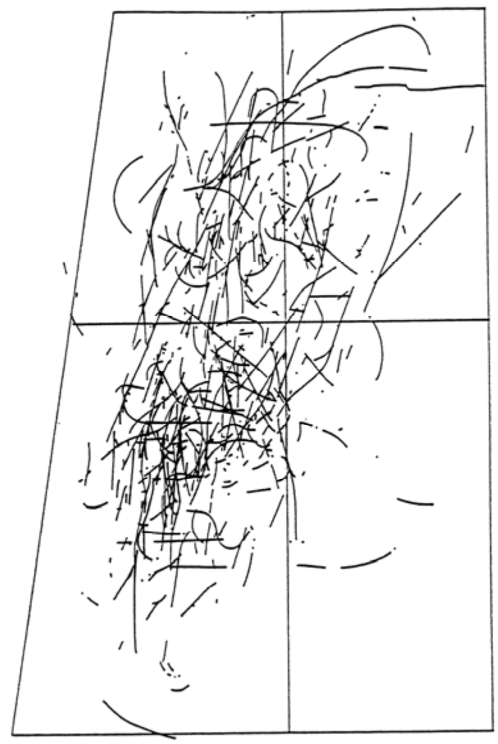


Figure 8. Supersonic Flight Tracks in Supersonic Air Combat Training Airspace

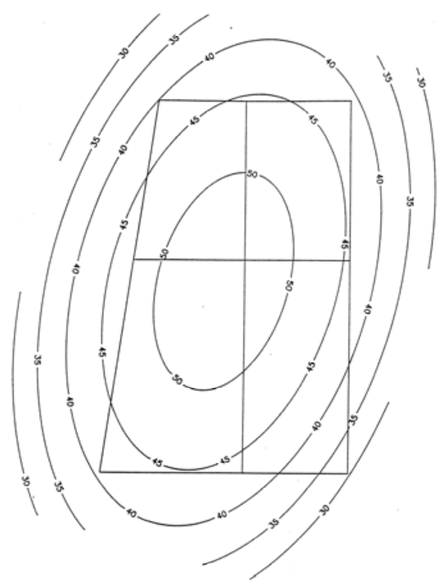


Figure 9. Elliptical CDNL Contours in Supersonic Air Combat Training Airspace

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Appendix F
Aircraft Operations Emissions Data

Table 1. Construction and Paving Projects Included in the Proposed Action.

	Buildings	Pavement			Surface	
	Building Area	Pavement Area	Pavement Depth	Pavement Volume	Total Area	
Project Details	SF	SF	Feet	CF	SF	
Construct Low Observable /Composite Repair Facility	37,965			0	37,965	
Construct Squadron Ops/AMU/6-Bay Hangar	72,172			0	72,172	
ADAL AGE Repair/Storage Facility	6,900			0	6,900	
Upgrade Munitions Mx and Storage	13,260			0	13,260	
Construct Fuel Tank Storage	6,500			0	6,500	
Construct F-22 Simulator Facility	22,700			0	22,700	
Construct Weapons Load Training Facility	17,100			0	17,100	
Construct Field Training Detachment	10,150			0	10,150	
F-22 Parts Store	13,560			0	13,560	
Weapons Release Shop	17,000			0	17,000	
Upgrade Communications Infrastructure				0	0	
Alter Wheel and Tire Shop				0	0	
Alter Jet Engine Maintenance Shop				0	0	
Alter Parking Apron				0	0	
Alter Power Check Pad				0	0	
Alter Hush House				0	0	
Alter Fuel Cell/Corrosion Control				0	0	
General Paving		217,800		0	217,800	
Totals	217,307	217,800		0	9.99	acres

Table 2. Demolition Projects Included in the Proposed Action.

	Buildings	Pavement	Pavement Depth	Pavement Volume
Project Details	Sq Feet	Sq Feet	Feet	CF
General Demolition	200,000			0
				0
				0
Totals	200,000	0		0

Table 3. Emission Factors for the Hickam AFB Proposed Action.

Source Type	Units	Emission Factors						References
		VOC	CO	NOx	SOx	PM10	PM2.5	
Construction/Demolition Sources								
Heavy Duty Diesel Vehicles - Idle	Gms/Hr	5.00	30.04	67.52	0.04	1.39	1.28	(8)
Heavy-Duty Diesel Vehicles	Gms/Mile	0.49	2.84	10.15	0.04	0.32	0.27	(1) (7)
Light-Duty Gasoline Vehicles	Gms/Mile	1.64	17.08	0.77	0.01	0.03	0.01	(1) (7)
Composite of All Onroad Vehicles	Gms/Mile	1.69	17.68	1.79	0.01	0.05	0.04	(1) (7)
Grader - 180 Hp	Gms/Hp-Hr	0.33	1.31	4.42	0.75	0.32	0.31	(2)
Scraper - 195 Hp	Gms/Hp-Hr	0.33	1.34	4.47	0.75	0.32	0.31	(2)
Roller - 165 Hp	Gms/Hp-Hr	0.40	1.73	4.94	0.75	0.39	0.38	(2)
Backhoe - 160 Hp	Gms/Hp-Hr	1.23	4.79	7.19	0.87	0.82	0.79	(2)
Paving Machine - 200 Hp	Gms/Hp-Hr	0.34	1.40	4.60	0.75	0.33	0.32	(2)
Bulldozer -165 Hp	Gms/Hp-Hr	0.38	1.57	4.68	0.75	0.38	0.37	(2)
Bulldozer - 310 Hp	Gms/Hp-Hr	0.29	2.13	5.08	0.75	0.32	0.31	(2)
Air Compressor - 50 Hp	Gms/Hp-Hr	0.51	3.21	4.77	0.83	0.62	0.60	(2)
Concrete/Industrial Saw - 84 Hp	Gms/Hp-Hr	0.69	4.53	5.59	0.83	0.76	0.74	(2)
Crane - 190 Hp	Gms/Hp-Hr	0.34	0.99	4.99	0.74	0.27	0.27	(2)
Forklift - 94 Hp	Gms/Hp-Hr	0.65	4.36	5.40	0.83	0.72	0.70	(2)
Loader - 215 Hp	Gms/Hp-Hr	1.13	4.35	6.93	0.87	0.76	0.73	(2)
Water Truck - 175 Hp	Gms/Hp-Hr	0.35	1.42	4.05	0.75	0.35	0.34	(2)
Generator - 45 Hp	Gms/Hp-Hr	0.51	3.21	4.77	0.83	0.62	0.60	(2)
Fugitive Dust	lbs/acre-day	---	---	---	---	26.90	5.59	(3) (7)
Building Demolition	lbs/1000 cf	---	---	---	---	0.42	0.09	(4) (7)
Aircraft								
F-15 - Idle	lbs/1000 lbs of fuel	8.60	35.29	4.38	1.34	2.06	2.04	(5) (7)
F-15 - Approach	lbs/1000 lbs of fuel	0.16	3.49	12.33	1.34	2.63	2.61	(5) (7)
F-15 - Intermediate	lbs/1000 lbs of fuel	0.14	0.91	30.89	1.34	2.06	2.04	(5) (7)
F-15 - Military	lbs/1000 lbs of fuel	0.28	0.90	39.44	1.34	1.33	1.32	(5) (7)
F-15 - AB	lbs/1000 lbs of fuel	0.05	9.57	6.62	1.34	1.15	1.14	(5) (7)
F-15 - LTOs	lbs/LTO	9.49	39.88	20.31	2.34	3.68	3.65	(5) (7)
F-15 - TGOs	lbs/TGO	0.12	1.42	15.54	0.88	1.44	1.43	(5) (7)
F-22A - Idle	lbs/hr	9.36	66.37	4.14	1.34	3.44	3.41	(7) (9)
F-22A - Approach	lbs/hr	0.82	21.65	18.11	1.34	5.48	5.43	(7) (9)
F-22A - Climbout	lbs/hr	5.06	21.23	125.16	1.34	15.17	15.03	(7) (9)
F-22A - Takeoff	lbs/hr	0.00	14.89	369.26	1.34	39.09	38.74	(7) (9)
F-22A - LTOs	lbs/LTO	9.53	69.22	14.49	1.54	4.98	4.94	(7) (9)
F-22A - TGOs	lbs/TGO	0.23	3.29	10.37	0.21	1.57	1.55	(7) (9)

Notes: (1) Obtained from the USEPA's MOBILE6 emissions model for a US average fleet age distrubition, climate and fuel compostion for Honolulu County, Hawaii, year 2007.

(2) Obtained from the USEPA's NONROAD2005 emissions model for a Honolulu County, Hawaii for the year 2007.

(3) Units in lbs/acre-day from section 11.2.3 of AP-42 (EPA 1995). Emissions reduced by 50% from uncontrolled levels to represent use of Best Management Practices to reduce fugitive dust emissions.

(4) CEQA Air Quality Handbook, Table 9-2 (SCAQMD 1993). Building demolition units in lbs of pollutant/1000 cubic feet (cf) of demolished building. Construction - General Industrial in units of lbs of pollutant/1000 square feet (sf).

(5) From Untied States Air Force Air Emissions Inventory Guidance Document for Mobile Sources at Air Force Installations (USAF 2003). LTO = Landing and Takeoff Cycle, TGO = Touch and Go cycle.

(7) PM2.5 fractions obtained from California Emissions Inventory Development and Reporting System (CEIDARS) Table PMSIZEPROFILE (ARB 2006). http://www.arb.ca.gov/app/emsinv/dist/utltab/lookup/display_tab.php?tname=PMSIZEPROFILE&page=1&recnum=123&npages=2

(8) Idling emission factors developed from EMFAC2002 (ARB 2003), for the year 2007. Units in grams/hour.

(9) Obtained from Air Force Institute for Operational Health, Air Quality Branch.

Table 4. Aircraft Time-in-Mode Per Cycle in Hours.

Mode	LTO F-15	LTO F-22A	TGO F-15	TGO F-22A	Fuel Use (lbs/hr) F-15	Fuel Use (lbs/hr) F-22A
Taxi Out	0.308	0.308	---	---	1,097	1,377
Take Off	0.007	0.007	0.007	0.007	10,104	18,612
Climb Out	0.013	0.013	0.013	0.013	7,617	10,110
Approach	0.058	0.058	0.058	0.058	2,745	2,740
Taxi In	0.188	0.188	---	---	1,097	1,377

Source: All data obtained from United States Air Force Emissions Inventory Guidance Document for Mobile Sources at Air Force Installations (USAF 2003), except F-22A fuel usage obtained from the Air Force Institute for Operational Health, Air Quality Branch.

Table 5. Aircraft Emissions - Hickam AFB - Proposed Action.

F-15		Emission Factors (lb/LTO)						Emissions (lbs/year)					
	Sorties/year	VOC	CO	NOx	SOx	PM10	PM2.5	VOC	CO	NOx	SOx	PM10	PM2.5
Local Sorties	2640	9.49	39.88	20.31	2.34	3.68	3.65	25,050	105,280	53,616	6,183	9,727	9,640
Cross-country sorties		9.49	39.88	20.31	2.34	3.68	3.65	0	0	0	0	0	0
		Emission Factors (lb/TGO)						Emissions (lbs/year)					
		VOC	CO	NOx	SOx	PM10	PM2.5	VOC	CO	NOx	SOx	PM10	PM2.5
Closed Patterns/T&Gs/Low Approaches		0.12	1.42	15.54	0.88	1.44	1.43	0	0	0	0	0	0
TOTAL	2640						(lbs)	25,050	105,280	53,616	6,183	9,727	9,640
							(tons)	12.53	52.64	26.81	3.09	4.86	4.82

F-22A		Emission Factors (lb/LTO)						Emissions (lbs/year)					
	Sorties/year	VOC	CO	NOx	SOx	PM10	PM2.5	VOC	CO	NOx	SOx	PM10	PM2.5
Local Sorties	3960	9.53	69.22	14.49	1.54	4.98	4.94	37,732	274,103	57,366	6,102	19,729	19,552
Cross-country sorties		9.53	69.22	14.49	1.54	4.98	4.94	0	0	0	0	0	0
		Emission Factors (lb/TGO)						Emissions (lbs/year)					
		VOC	CO	NOx	SOx	PM10	PM2.5	VOC	CO	NOx	SOx	PM10	PM2.5
Closed Patterns/T&Gs/Low Approaches		0.23	3.29	10.37	0.21	1.57	1.55	0	0	0	0	0	0
TOTAL	3960						(lbs)	37,732	274,103	57,366	6,102	19,729	19,552
							(tons)	18.87	137.05	28.68	3.05	9.86	9.78

Table 6. Aircraft Engine Testing Emissions - Hickam AFB - Proposed Action.

Engine Type	Power Setting	Hrs per Year (1)	Fuel Flow Rate (lb fuel /hr)	Emission Factor (lb/1000 lb fuel) F100-PW-100						Emissions (lb/yr)					
				VOC	CO	NOx	SO2	PM-10	PM-2.5	VOC	CO	NOx	SO2	PM-10	PM-2.5
F-15:	Idle	144	1,097	8.60	35.29	4.38	1.34	2.06	2.04	1,359	5,575	692	212	325	322
F-110-PW-100	Approach	324	2,745	0.16	3.49	12.33	1.34	2.63	2.61	142	3,104	10,966	1,192	2,339	2,318
	Intermediate	108	7,617	0.14	0.91	30.89	1.34	2.06	2.04	115	749	25,411	1,102	1,695	1,679
	Military	108	10,104	0.28	0.90	39.44	1.34	1.33	1.32	306	982	43,038	1,462	1,451	1,438
	AB	36	54,074	0.05	9.57	6.62	1.34	1.15	1.14	97	18,630	12,887	2,609	2,239	2,219
TOTAL EMISSIONS (lb/yr)										2,019	29,039	92,994	6,577	8,049	7,977
TOTAL EMISSIONS (tons/yr)										1.01	14.52	46.50	3.29	4.02	3.99

Engine Type	Power Setting	Hrs per Year (1)	Fuel Flow Rate (lb fuel /hr)	Emission Factor (lb/hr)						Emissions (lb/yr)					
				VOC	CO	NOx	SO2	PM-10	PM-2.5	VOC	CO	NOx	SO2	PM-10	PM-2.5
F-22A:	Idle	173	1,377	9.36	66.37	4.14	1.34	3.44	3.41	1,617	11,469	715	232	594	589
F-119-PW-100	Approach	389	18,612	0.82	21.65	18.11	1.34	5.48	5.43	319	8,418	7,041	521	2,131	2,111
	Climbout	130	10,110	5.06	21.23	125.16	1.34	15.17	15.03	656	2,751	16,221	174	1,966	1,948
	Takeoff	130	2,740	0.00	14.89	369.26	1.34	39.09	38.74	-	1,930	47,856	174	5,066	5,020
	AB	43	54,074	0.05	9.57	6.62	1.34	1.15	1.14	117	22,355	15,464	3,130	2,686	2,662
TOTAL EMISSIONS (lb/yr)										2,709	46,923	87,298	4,230	12,444	12,332
TOTAL EMISSIONS (tons/yr)										1.35	23.46	43.65	2.12	6.22	6.17

Notes: (1) Used annual time in mode from ACAM model (AFCEE 2005) and increased by a factor of two, as the times listed were per aircraft, and there are two engines per aircraft.

(2) Assumed Afterburner emission factors for F-22A were the same as those from F-15, as data was not available.

Table 7. Change in Emissions due to Change in Primary Assigned Aircraft and Increase in Operations.

Source	Annual Emissions (Tons)					
	VOC	CO	NOx	SOx	PM10	PM2.5
Aircraft Operations						
F-15	12.53	52.64	26.81	3.09	4.86	4.82
F-22A	18.87	137.05	28.68	3.05	9.86	9.78
Change	6.34	84.41	1.87	(0.04)	5.00	4.96
Engine Testing						
F-15	1.01	14.52	46.50	3.29	4.02	3.99
F-22A	1.35	23.46	43.65	2.12	6.22	6.17
Change	0.34	8.94	(2.85)	(1.17)	2.20	2.18
Total Change	6.69	93.35	(0.97)	(1.21)	7.20	7.13

Table 8. Emissions Source Data - Construct Low Observable /Composite Repair Facility

Construction Activity/Equipment Type	*Hp Rating*	*Ave. Daily Load Factor*	*Number Active*	*Hourly Hp-Hrs*	*Hours/ Day*	*Daily Hp-Hrs*	*Work Days (1)*	*Total Hp-Hrs*
Air Compressor - 100 CFM	50	0.60	1	30	6	180	171	30,752
Concrete/Industrial Saw	84	0.73	1	61	6	368	171	62,856
Crane	190	0.30	1	57	6	342	171	58,428
Forklift	94	0.48	1	45	6	268	171	45,769
Generator	45	0.60	1	27	8	216	171	36,902
Concrete Trucks (2)	NA	NA	20	NA	14	280	8	2,174
Supply Trucks (2)	NA	NA	20	NA	10	200	13	2,589
Fugitive Dust (3)	NA	NA	1	NA	8	NA	41	41

Notes: (1) Work days determined by mulitplying days from POLA-TraPac-DEIR (POLA 2006) project - construction of an admisitrative building (440,000 cf) by the ratio of the volume of building to be constructed/440,000 cf.

(2) Number Active = miles/roundtrip, Hours/Day = daily truck trips, Daily Hp-Hrs = daily miles, and Total Hp-Hrs = total miles.

(3) Number Active is acres disturbed at one time and Total Hp-Hrs is acre-days for the entire activity.

Table 9. Emissions Source Data - Construct Squadron Ops/AMU/6-Bay Hangar

Construction Activity/Equipment Type	*Hp Rating*	*Ave. Daily Load Factor*	*Number Active*	*Hourly Hp-Hrs*	*Hours/ Day*	*Daily Hp-Hrs*	*Work Days (1)*	*Total Hp-Hrs*
Air Compressor - 100 CFM	50	0.60	1	30	6	180	325	58,459
Concrete/Industrial Saw	84	0.73	1	61	6	368	325	119,491
Crane	190	0.30	1	57	6	342	325	111,073
Forklift	94	0.48	1	45	6	268	325	87,007
Generator	45	0.60	1	27	8	216	325	70,151
Concrete Trucks (2)	NA	NA	20	NA	14	280	15	4,133
Supply Trucks (2)	NA	NA	20	NA	10	200	25	4,921
Fugitive Dust (3)	NA	NA	1	NA	8	NA	79	79

Notes: (1) Work days determined by mulitplying days from POLA-TraPac-DEIR (POLA 2006) project - construction of an admisitrative building (440,000 cf) by the ratio of the volume of building to be constructed/440,000 cf.

(2) Number Active = miles/roundtrip, Hours/Day = daily truck trips, Daily Hp-Hrs = daily miles, and Total Hp-Hrs = total miles.

(3) Number Active is acres disturbed at one time and Total Hp-Hrs is acre-days for the entire activity.

Table 10. Emissions Source Data - Upgrade Munitions Mx and Storage

Construction Activity/Equipment Type	*Hp Rating*	*Ave. Daily Load Factor*	*Number Active*	*Hourly Hp-Hrs*	*Hours/ Day*	*Daily Hp-Hrs*	*Work Days (1)*	*Total Hp-Hrs*
Air Compressor - 100 CFM	50	0.60	1	30	6	180	30	5,370
Concrete/Industrial Saw	84	0.73	1	61	6	368	30	10,977
Crane	190	0.30	1	57	6	342	30	10,204
Forklift	94	0.48	1	45	6	268	30	7,993
Generator	45	0.60	1	27	8	216	30	6,444
Concrete Trucks (2)	NA	NA	20	NA	14	280	1	380
Supply Trucks (2)	NA	NA	20	NA	10	200	2	452
Fugitive Dust (3)	NA	NA	1	NA	8	NA	7	7

Notes: (1) Work days determined by mulitplying days from POLA-TraPac-DEIR (POLA 2006) project - construction of an admisitrative building (440,000 cf) by the ratio of the volume of building to be constructed/440,000 cf.

(2) Number Active = miles/roundtrip, Hours/Day = daily truck trips, Daily Hp-Hrs = daily miles, and Total Hp-Hrs = total miles.

(3) Number Active is acres disturbed at one time and Total Hp-Hrs is acre-days for the entire activity.

Table 11. Emissions Source Data - Construct Fuel Tank Storage

Construction Activity/Equipment Type	*Hp Rating*	*Ave. Daily Load Factor*	*Number Active*	*Hourly Hp-Hrs*	*Hours/ Day*	*Daily Hp-Hrs*	*Work Days (1)*	*Total Hp-Hrs*
Air Compressor - 100 CFM	50	0.60	1	30	6	180	15	2,633
Concrete/Industrial Saw	84	0.73	1	61	6	368	15	5,381
Crane	190	0.30	1	57	6	342	15	5,002
Forklift	94	0.48	1	45	6	268	15	3,918
Generator	45	0.60	1	27	8	216	15	3,159
Concrete Trucks (2)	NA	NA	20	NA	14	280	1	186
Supply Trucks (2)	NA	NA	20	NA	10	200	1	222
Fugitive Dust (3)	NA	NA	1	NA	8	NA	4	4

Notes: (1) Work days determined by mulitplying days from POLA-TraPac-DEIR (POLA 2006) project - construction of an admisitrative building (440,000 cf) by the ratio of the volume of building to be constructed/440,000 cf.

(2) Number Active = miles/roundtrip, Hours/Day = daily truck trips, Daily Hp-Hrs = daily miles, and Total Hp-Hrs = total miles.

(3) Number Active is acres disturbed at one time and Total Hp-Hrs is acre-days for the entire activity.

Table 12. Emissions Source Data - Construct F-22 Simulator Facility

Construction Activity/Equipment Type	*Hp Rating*	*Ave. Daily Load Factor*	*Number Active*	*Hourly Hp-Hrs*	*Hours/ Day*	*Daily Hp-Hrs*	*Work Days (1)*	*Total Hp-Hrs*
Air Compressor - 100 CFM	50	0.60	1	30	6	180	51	9,194
Concrete/Industrial Saw	84	0.73	1	61	6	368	51	18,792
Crane	190	0.30	1	57	6	342	51	17,468
Forklift	94	0.48	1	45	6	268	51	13,683
Generator	45	0.60	1	27	8	216	51	11,032
Concrete Trucks (2)	NA	NA	20	NA	14	280	2	650
Supply Trucks (2)	NA	NA	20	NA	10	200	4	774
Fugitive Dust (3)	NA	NA	1	NA	8	NA	12	12

Notes: (1) Work days determined by mulitplying days from POLA-TraPac-DEIR (POLA 2006) project - construction of an admisitrative building (440,000 cf) by the ratio of the volume of building to be constructed/440,000 cf.

(2) Number Active = miles/roundtrip, Hours/Day = daily truck trips, Daily Hp-Hrs = daily miles, and Total Hp-Hrs = total miles.

(3) Number Active is acres disturbed at one time and Total Hp-Hrs is acre-days for the entire activity.

Table 13. Emissions Source Data - Construct Weapons Load Training Facility

Construction Activity/Equipment Type	*Hp Rating*	*Ave. Daily Load Factor*	*Number Active*	*Hourly Hp-Hrs*	*Hours/ Day*	*Daily Hp-Hrs*	*Work Days (1)*	*Total Hp-Hrs*
Air Compressor - 100 CFM	50	0.60	1	30	6	180	38	6,926
Concrete/Industrial Saw	84	0.73	1	61	6	368	38	14,156
Crane	190	0.30	1	57	6	342	38	13,158
Forklift	94	0.48	1	45	6	268	38	10,307
Generator	45	0.60	1	27	8	216	38	8,311
Concrete Trucks (2)	NA	NA	20	NA	14	280	2	490
Supply Trucks (2)	NA	NA	20	NA	10	200	3	583
Fugitive Dust (3)	NA	NA	1	NA	8	NA	9	9

Notes: (1) Work days determined by mulitplying days from POLA-TraPac-DEIR (POLA 2006) project - construction of an admisitrative building (440,000 cf) by the ratio of the volume of building to be constructed/440,000 cf.

(2) Number Active = miles/roundtrip, Hours/Day = daily truck trips, Daily Hp-Hrs = daily miles, and Total Hp-Hrs = total miles.

(3) Number Active is acres disturbed at one time and Total Hp-Hrs is acre-days for the entire activity.

Table 14. Emissions Source Data - Construct Field Training Detachment

Construction Activity/Equipment Type	*Hp Rating*	*Ave. Daily Load Factor*	*Number Active*	*Hourly Hp-Hrs*	*Hours/ Day*	*Daily Hp-Hrs*	*Work Days (1)*	*Total Hp-Hrs*
Air Compressor - 100 CFM	50	0.60	1	30	6	180	23	4,111
Concrete/Industrial Saw	84	0.73	1	61	6	368	23	8,402
Crane	190	0.30	1	57	6	342	23	7,810
Forklift	94	0.48	1	45	6	268	23	6,118
Generator	45	0.60	1	27	8	216	23	4,933
Concrete Trucks (2)	NA	NA	20	NA	14	280	1	291
Supply Trucks (2)	NA	NA	20	NA	10	200	2	346
Fugitive Dust (3)	NA	NA	1	NA	8	NA	6	6

Notes: (1) Work days determined by mulitplying days from POLA-TraPac-DEIR (POLA 2006) project - construction of an admisitrative building (440,000 cf) by the ratio of the volume of building to be constructed/440,000 cf.

(2) Number Active = miles/roundtrip, Hours/Day = daily truck trips, Daily Hp-Hrs = daily miles, and Total Hp-Hrs = total miles.

(3) Number Active is acres disturbed at one time and Total Hp-Hrs is acre-days for the entire activity.

Table 15. Emissions Source Data - ADAL AGE Repair/Storage Facility

Construction Activity/Equipment Type	*Hp Rating*	*Ave. Daily Load Factor*	*Number Active*	*Hourly Hp-Hrs*	*Hours/ Day*	*Daily Hp-Hrs*	*Work Days (1)*	*Total Hp-Hrs*
Air Compressor - 100 CFM	50	0.60	1	30	6	180	16	2,795
Concrete/Industrial Saw	84	0.73	1	61	6	368	16	5,712
Crane	190	0.30	1	57	6	342	16	5,310
Forklift	94	0.48	1	45	6	268	16	4,159
Generator	45	0.60	1	27	8	216	16	3,353
Concrete Trucks (2)	NA	NA	20	NA	14	280	1	198
Supply Trucks (2)	NA	NA	20	NA	10	200	1	235
Fugitive Dust (3)	NA	NA	1	NA	8	NA	4	4

Notes: (1) Work days determined by mulitplying days from POLA-TraPac-DEIR (POLA 2006) project - construction of an admisitrative building (440,000 cf) by the ratio of the volume of building to be constructed/440,000 cf.

(2) Number Active = miles/roundtrip, Hours/Day = daily truck trips, Daily Hp-Hrs = daily miles, and Total Hp-Hrs = total miles.

(3) Number Active is acres disturbed at one time and Total Hp-Hrs is acre-days for the entire activity.

Table 16. Emissions Source Data - F-22A Parts Store

Construction Activity/Equipment Type	*Hp Rating*	*Ave. Daily Load Factor*	*Number Active*	*Hourly Hp-Hrs*	*Hours/ Day*	*Daily Hp-Hrs*	*Work Days (1)*	*Total Hp-Hrs*
Air Compressor - 100 CFM	50	0.60	1	30	6	180	31	5,492
Concrete/Industrial Saw	84	0.73	1	61	6	368	31	11,225
Crane	190	0.30	1	57	6	342	31	10,434
Forklift	94	0.48	1	45	6	268	31	8,174
Generator	45	0.60	1	27	8	216	31	6,590
Concrete Trucks (2)	NA	NA	20	NA	14	280	1	388
Supply Trucks (2)	NA	NA	20	NA	10	200	2	462
Fugitive Dust (3)	NA	NA	1	NA	8	NA	7	7

Notes: (1) Work days determined by mulitplying days from POLA-TraPac-DEIR (POLA 2006) project - construction of an admisitrative building (440,000 cf) by the ratio of the volume of building to be constructed/440,000 cf.

(2) Number Active = miles/roundtrip, Hours/Day = daily truck trips, Daily Hp-Hrs = daily miles, and Total Hp-Hrs = total miles.

(3) Number Active is acres disturbed at one time and Total Hp-Hrs is acre-days for the entire activity.

Table 17. Emissions Source Data - Weapons Release Shop

Construction Activity/Equipment Type	*Hp Rating*	*Ave. Daily Load Factor*	*Number Active*	*Hourly Hp-Hrs*	*Hours/ Day*	*Daily Hp-Hrs*	*Work Days (1)*	*Total Hp-Hrs*
Air Compressor - 100 CFM	50	0.60	1	30	6	180	38	6,885
Concrete/Industrial Saw	84	0.73	1	61	6	368	38	14,073
Crane	190	0.30	1	57	6	342	38	13,082
Forklift	94	0.48	1	45	6	268	38	10,247
Generator	45	0.60	1	27	8	216	38	8,262
Concrete Trucks (2)	NA	NA	20	NA	14	280	2	487
Supply Trucks (2)	NA	NA	20	NA	10	200	3	580
Fugitive Dust (3)	NA	NA	1	NA	8	NA	9	9

Notes: (1) Work days determined by mulitplying days from POLA-TraPac-DEIR (POLA 2006) project - construction of an admisitrative building (440,000 cf) by the ratio of the volume of building to be constructed/440,000 cf.

(2) Number Active = miles/roundtrip, Hours/Day = daily truck trips, Daily Hp-Hrs = daily miles, and Total Hp-Hrs = total miles.

(3) Number Active is acres disturbed at one time and Total Hp-Hrs is acre-days for the entire activity.

Table 18. Construction Emissions - Construct Low Observable /Composite Repair Facility

	Total Emissions (Tons)					
Construction Activity/Equipment Type	*VOC*	*CO*	*NOx*	*SOx*	*PM10*	*PM2.5*
Air Compressor - 100 CFM	0.02	0.11	0.16	0.03	0.02	0.02
Concrete/Industrial Saw	0.05	0.31	0.39	0.06	0.05	0.05
Crane	0.02	0.06	0.32	0.05	0.02	0.02
Forklift	0.03	0.22	0.27	0.04	0.04	0.04
Generator	0.02	0.13	0.19	0.03	0.03	0.02
Concrete Trucks (1)	0.00	0.01	0.03	0.00	0.00	0.00
Supply Trucks (1)	0.00	0.01	0.03	0.00	0.00	0.00
Fugitive Dust	---	---	---	---	0.56	0.12
Subtotal	0.14	0.85	1.39	0.21	0.71	0.27

Notes: (1) Includes 5 minutes of idling time per round trip.

Table 19. Construction Emissions - Construct Squadron Ops/AMU/6-Bay Hangar

	Total Emissions (Tons)					
Construction Activity/Equipment Type	*VOC*	*CO*	*NOx*	*SOx*	*PM10*	*PM2.5*
Air Compressor - 100 CFM	0.03	0.21	0.31	0.05	0.04	0.04
Concrete/Industrial Saw	0.09	0.60	0.74	0.11	0.10	0.10
Crane	0.04	0.12	0.61	0.09	0.03	0.03
Forklift	0.06	0.42	0.52	0.08	0.07	0.07
Generator	0.04	0.25	0.37	0.06	0.05	0.05
Concrete Trucks (1)	0.00	0.01	0.05	0.00	0.00	0.00
Supply Trucks (1)	0.00	0.02	0.06	0.00	0.00	0.00
Fugitive Dust	---	---	---	---	1.06	0.22
Subtotal	0.27	1.62	2.65	0.40	1.35	0.51

Notes: (1) Includes 5 minutes of idling time per round trip.

Table 20. Construction Emissions - Upgrade Munitions Mx and Storage

	Total Emissions (Tons)					
Construction Activity/Equipment Type	*VOC*	*CO*	*NOx*	*SOx*	*PM10*	*PM2.5*
Air Compressor - 100 CFM	0.00	0.02	0.03	0.00	0.00	0.00
Concrete/Industrial Saw	0.01	0.05	0.07	0.01	0.01	0.01
Crane	0.00	0.01	0.06	0.01	0.00	0.00
Forklift	0.01	0.04	0.05	0.01	0.01	0.01
Generator	0.00	0.02	0.03	0.01	0.00	0.00
Concrete Trucks (1)	0.00	0.00	0.00	0.00	0.00	0.00
Supply Trucks (1)	0.00	0.00	0.01	0.00	0.00	0.00
Fugitive Dust	---	---	---	---	0.10	0.02
Subtotal	0.03	0.15	0.24	0.04	0.12	0.05

Notes: (1) Includes 5 minutes of idling time per round trip.

Table 21. Construction Emissions - Construct Fuel Tank Storage

	Total Emissions (Tons)					
Construction Activity/Equipment Type	*VOC*	*CO*	*NOx*	*SOx*	*PM10*	*PM2.5*
Air Compressor - 100 CFM	0.00	0.01	0.01	0.00	0.00	0.00
Concrete/Industrial Saw	0.00	0.03	0.03	0.00	0.00	0.00
Crane	0.00	0.01	0.03	0.00	0.00	0.00
Forklift	0.00	0.02	0.02	0.00	0.00	0.00
Generator	0.00	0.01	0.02	0.00	0.00	0.00
Concrete Trucks (1)	0.00	0.00	0.00	0.00	0.00	0.00
Supply Trucks (1)	0.00	0.00	0.00	0.00	0.00	0.00
Fugitive Dust	---	---	---	---	0.05	0.01
Subtotal	0.01	0.07	0.12	0.02	0.06	0.02

Notes: (1) Includes 5 minutes of idling time per round trip.

Table 22. Construction Emissions - Construct F-22 Simulator Facility

	Total Emissions (Tons)					
Construction Activity/Equipment Type	*VOC*	*CO*	*NOx*	*SOx*	*PM10*	*PM2.5*
Air Compressor - 100 CFM	0.01	0.03	0.05	0.01	0.01	0.01
Concrete/Industrial Saw	0.01	0.09	0.12	0.02	0.02	0.02
Crane	0.01	0.02	0.10	0.01	0.01	0.01
Forklift	0.01	0.07	0.08	0.01	0.01	0.01
Generator	0.01	0.04	0.06	0.01	0.01	0.01
Concrete Trucks (1)	0.00	0.00	0.01	0.00	0.00	0.00
Supply Trucks (1)	0.00	0.00	0.01	0.00	0.00	0.00
Fugitive Dust	---	---	---	---	0.17	0.03
Subtotal	0.04	0.25	0.42	0.06	0.21	0.08

Notes: (1) Includes 5 minutes of idling time per round trip.

Table 23. Construction Emissions - Construct Weapons Load Training Facility

	Total Emissions (Tons)					
Construction Activity/Equipment Type	*VOC*	*CO*	*NOx*	*SOx*	*PM10*	*PM2.5*
Air Compressor - 100 CFM	0.00	0.02	0.04	0.01	0.00	0.00
Concrete/Industrial Saw	0.01	0.07	0.09	0.01	0.01	0.01
Crane	0.00	0.01	0.07	0.01	0.00	0.00
Forklift	0.01	0.05	0.06	0.01	0.01	0.01
Generator	0.00	0.03	0.04	0.01	0.01	0.01
Concrete Trucks (1)	0.00	0.00	0.01	0.00	0.00	0.00
Supply Trucks (1)	0.00	0.00	0.01	0.00	0.00	0.00
Fugitive Dust	---	---	---	---	0.13	0.03
Subtotal	0.03	0.19	0.31	0.05	0.16	0.06

Notes: (1) Includes 5 minutes of idling time per round trip.

Table 24. Construction Emissions - Construct Field Training Detachment

	Total Emissions (Tons)					
Construction Activity/Equipment Type	*VOC*	*CO*	*NOx*	*SOx*	*PM10*	*PM2.5*
Air Compressor - 100 CFM	0.00	0.01	0.02	0.00	0.00	0.00
Concrete/Industrial Saw	0.01	0.04	0.05	0.01	0.01	0.01
Crane	0.00	0.01	0.04	0.01	0.00	0.00
Forklift	0.00	0.03	0.04	0.01	0.00	0.00
Generator	0.00	0.02	0.03	0.00	0.00	0.00
Concrete Trucks (1)	0.00	0.00	0.00	0.00	0.00	0.00
Supply Trucks (1)	0.00	0.00	0.00	0.00	0.00	0.00
Fugitive Dust	---	---	---	---	0.07	0.02
Subtotal	0.02	0.11	0.19	0.03	0.10	0.04

Notes: (1) Includes 5 minutes of idling time per round trip.

Table 25. Construction Emissions - ADAL AGE Repair/Storage Facility

	Total Emissions (Tons)					
Construction Activity/Equipment Type	*VOC*	*CO*	*NOx*	*SOx*	*PM10*	*PM2.5*
Air Compressor - 100 CFM	0.00	0.01	0.01	0.00	0.00	0.00
Concrete/Industrial Saw	0.00	0.03	0.04	0.01	0.00	0.00
Crane	0.00	0.01	0.03	0.00	0.00	0.00
Forklift	0.00	0.02	0.02	0.00	0.00	0.00
Generator	0.00	0.01	0.02	0.00	0.00	0.00
Concrete Trucks (1)	0.00	0.00	0.00	0.00	0.00	0.00
Supply Trucks (1)	0.00	0.00	0.00	0.00	0.00	0.00
Fugitive Dust	---	---	---	---	0.05	0.01
Subtotal	0.01	0.08	0.13	0.02	0.06	0.02

Notes: (1) Includes 5 minutes of idling time per round trip.

Table 26. Construction Emissions - F-22A Parts Store

	Total Emissions (Tons)					
Construction Activity/Equipment Type	*VOC*	*CO*	*NOx*	*SOx*	*PM10*	*PM2.5*
Air Compressor - 100 CFM	0.00	0.02	0.03	0.01	0.00	0.00
Concrete/Industrial Saw	0.01	0.06	0.07	0.01	0.01	0.01
Crane	0.00	0.01	0.06	0.01	0.00	0.00
Forklift	0.01	0.04	0.05	0.01	0.01	0.01
Generator	0.00	0.02	0.03	0.01	0.00	0.00
Concrete Trucks (1)	0.00	0.00	0.00	0.00	0.00	0.00
Supply Trucks (1)	0.00	0.00	0.01	0.00	0.00	0.00
Fugitive Dust	---	---	---	---	0.10	0.02
Subtotal	0.03	0.15	0.25	0.04	0.13	0.05

Notes: (1) Includes 5 minutes of idling time per round trip.

Table 27. Construction Emissions - Weapons Release Shop

	Total Emissions (Tons)					
Construction Activity/Equipment Type	*VOC*	*CO*	*NOx*	*SOx*	*PM10*	*PM2.5*
Air Compressor - 100 CFM	0.00	0.02	0.04	0.01	0.00	0.00
Concrete/Industrial Saw	0.01	0.07	0.09	0.01	0.01	0.01
Crane	0.00	0.01	0.07	0.01	0.00	0.00
Forklift	0.01	0.05	0.06	0.01	0.01	0.01
Generator	0.00	0.03	0.04	0.01	0.01	0.01
Concrete Trucks (1)	0.00	0.00	0.01	0.00	0.00	0.00
Supply Trucks (1)	0.00	0.00	0.01	0.00	0.00	0.00
Fugitive Dust	---	---	---	---	0.12	0.03
Subtotal	0.03	0.19	0.31	0.05	0.16	0.06

Notes: (1) Includes 5 minutes of idling time per round trip.

Table 28. Total Emissions from Construction - Hickam AFB - Proposed Action.

	Total Emissions (Tons)					
Year	VOC	CO	NOx	SOx	PM10	PM2.5
Construct Low Observable /Composite Repair Facility	0.14	0.85	1.39	0.21	0.71	0.27
Construct Squadron Ops/AMU/6-Bay Hangar	0.27	1.62	2.65	0.40	1.35	0.51
Upgrade Munitions Mx and Storage	0.03	0.15	0.24	0.04	0.12	0.05
Construct Fuel Tank Storage	0.01	0.07	0.12	0.02	0.06	0.02
Construct F-22 Simulator Facility	0.04	0.25	0.42	0.06	0.21	0.08
Construct Weapons Load Training Facility	0.03	0.19	0.31	0.05	0.16	0.06
Construct Field Training Detachment	0.02	0.11	0.19	0.03	0.10	0.04
ADAL AGE Repair/Storage Facility	0.01	0.08	0.13	0.02	0.06	0.02
F-22A Parts Store	0.03	0.15	0.25	0.04	0.13	0.05
Weapons Release Shop	0.03	0.19	0.31	0.05	0.16	0.06
Proposed Action Total	0.62	3.67	6.00	0.90	3.07	1.15

Table 29. Paving Emission Source Data Hickam AFB - Proposed Action.

Construction Activity/Equipment Type	*Hp Rating*	*Ave. Daily Load Factor*	*Number Active*	*Hourly Hp-Hrs*	*Hours/ Day*	*Daily Hp-Hrs*	*Work Days (1)*	*Total Hp-Hrs*
General								
Paving Machine	200	0.50	1	100	8	800	2.0	1,571
Water Truck - 5000 Gallons	175	0.40	1	70	8	560	7.1	4,000
Compactive Roller	165	0.50	2	165	8	1,320	2.9	3,866
Scraper	195	0.50	2	195	8	1,560	2.9	4,569
Grader	180	0.50	1	90	8	720	3.3	2,340
Loader	215	0.50	1	108	8	860	3.3	2,795
Backhoe	160	0.50	1	80	8	640	2.3	1,463
Bulldozer - D6	165	0.50	1	83	8	660	2.3	1,509
Haul Truck - Paving (2)	NA	NA	20	NA	33	660	3.3	2,145
Haul Truck - Base (2)	NA	NA	20	NA	16	320	3.3	1,040
Semi Truck (2)	NA	NA	20	NA	16	320	3.3	1,040
Fugitive Dust (3)	NA	NA	5	NA	8	NA	7.1	36

Notes: (1) Work days determined by mulitplying days from POLA-TraPac-DEIR (POLA 2006) project - improve/pave demolished areas (14 acr
by the ratio of area of the region to be paved/14 acres.

(2) Number Active = miles/roundtrip, Hours/Day = daily truck trips, Daily Hp-Hrs = daily miles, and Total Hp-Hrs = total miles.

(3) Number Active is acres disturbed at one time and Total Hp-Hrs is acre-days for the entire activity.

Table 30. Paving Emissions - Hickam AFB - Proposed Action.

Construction Activity/Equipment Type	Total Emissions (Tons)					
	VOC	CO	NOx	SOx	PM10	PM2.5
ASE Shop - Equipment Parking Pad						
Paving Machine	0.00	0.00	0.01	0.00	0.00	0.00
Water Truck - 5000 Gallons	0.00	0.01	0.02	0.00	0.00	0.00
Compactive Roller	0.00	0.01	0.02	0.00	0.00	0.00
Scraper	0.00	0.01	0.02	0.00	0.00	0.00
Grader	0.00	0.00	0.01	0.00	0.00	0.00
Loader	0.00	0.01	0.02	0.00	0.00	0.00
Backhoe	0.00	0.01	0.01	0.00	0.00	0.00
Bulldozer - D6	0.00	0.00	0.01	0.00	0.00	0.00
Haul Truck - Paving (1)	0.00	0.01	0.02	0.00	0.00	0.00
Haul Truck - Base (1)	0.00	0.00	0.01	0.00	0.00	0.00
Semi Truck (1)	0.00	0.00	0.01	0.00	0.00	0.00
Fugitive Dust	---	---	---	---	0.48	0.10
Subtotal	0.01	0.06	0.17	0.02	0.49	0.11

Notes: (1) Includes 5 minutes of idling time per round trip.

Table 31. Demolition Emission Source Data - Hickam AFB - Proposed Action.

Construction Activity/Equipment Type	*Hp Rating*	*Ave. Daily Load Factor*	*Number Active*	*Hourly Hp-Hrs*	*Hours/ Day*	*Daily Hp-Hrs*	*Work Days (1)*	*Total Hp-Hrs*
General								
Backhoe	160	0.50	2	160	8	1,280	44.9	57,456
Bulldozer	310	0.50	2	310	8	2,480	44.9	111,322
Crane w/Wrecking Ball	180	0.50	1	90	8	720	44.9	32,319
Loader	215	0.50	3	323	8	2,580	44.9	115,810
Haul Truck (2)	NA	NA	20	NA	20	400	44.9	17,955
Building Demolition (3)	NA	NA	NA	NA	8	NA	44.9	4,000,000

Notes: (1) Work days determined by mulitplying days from POLA-TraPac-DEIR (POLA 2006) project - demolition of an admisitrative building (401,000 cf) by the ratio of volume of the building to be demolished/401,000 cf.

(2) Number Active = miles/roundtrip, Hours/Day = daily truck trips, Daily Hp-Hrs = daily miles, and Total Hp-Hrs = total miles.

(3) Total Hp-Hrs = total cubic feet (cf) of demolished buildings.

Table 32. Demolition Emissions - Hickam AFB - Proposed Action.

	Total Emissions (Tons)					
Construction Activity/Equipment Type	VOC	CO	NOx	SOx	PM10	PM2.5
Upgrade F-15 Parking Apron (old Shelters)						
Backhoe	0.08	0.30	0.46	0.06	0.05	0.05
Bulldozer	0.04	0.26	0.62	0.09	0.04	0.04
Crane w/Wrecking Ball	0.01	0.04	0.18	0.03	0.01	0.01
Loader	0.14	0.56	0.88	0.11	0.10	0.09
Haul Truck (1)	0.01	0.06	0.21	0.00	0.01	0.01
Building Demolition	---	---	---	---	0.84	0.17
Subtotal	0.28	1.21	2.35	0.29	1.04	0.37

Notes: (1) Includes 5 minutes of idling time per round trip.

Table 33. Total Construction Emissions - Hickam AFB - Proposed Action.

Source	Emissions (tons)					
	VOC	CO	NOx	SOx	PM10	PM2.5
Building Construction	0.62	3.67	6.00	0.90	3.07	1.15
Demolition	0.28	1.21	2.35	0.29	1.04	0.37
Paving	0.01	0.06	0.17	0.02	0.49	0.11
Total	0.92	4.95	8.52	1.21	4.61	1.63

ACRONYMS AND ABBREVIATIONS

°F	degree Fahrenheit
μg/m³	micrograms per cubic meter
15 AW	15th Airlift Wing
154 WG	154th Wing
199 FS	199th Fighter Squadron
201 CCG	201st Combat Communications Group
AAM	Annual Arithmetic Mean
AAQS	Ambient Air Quality Standards
ACAM	Air Conformity Applicability Model
ACM	Asbestos-Containing Material
AEF	Aerospace Expeditionary Forces
AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
AFI	Air Force Instruction
AFIERA	Air Force Institute for Environment, Safety, and Health Risk Analysis
AGL	above ground level
AICUZ	Air Installation Compatible Use Zone
Air Force	United States Air Force
ANG	Air National Guard
APE	are of potential effect
APZ	Accident Potential Zone
AQCR	Air Quality Control Region
AT/FP	Anti-Terrorism/Force Protection
ATC	Air Traffic Control
ATCAA	Air Traffic Control Assigned Airspace
ATCT	Air Traffic Control Tower
BAI	Backup Aircraft Inventory
BHPO	Base Historic Preservation Office
BMP	Best Management Practice
BRAC	Base Realignment and Closure
C&D	construction and debris
CAA	Clean Air Act
CATM	Combat Arms Training Maintenance
CDNL	C-weighted Day-Night Sound Level
CDP	census designated place
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CO	carbon monoxide
CRMP	Cultural Resources Management Plan
CZ	Clear Zone
dB	decibel
dBA	A-weighted decibel
dBC	C-weighted decibel
DoD	Department of Defense
DOL	United States Department of Labor
DOT	United States Department of Transportation
EA	Environmental Assessment
EAF	Expeditionary Air Force
EIS	Environmental Impact Statement
EMO	Environmental Management Office
EO	Executive Order
EOD	explosive ordnance disposal
EPCRA	Emergency Planning and Community Right-to-Know Act
ERP	Environmental Restoration Program
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FONPA	Finding of No Practicable Alternative
FONSI	Finding of No Significant Impact
FY	Fiscal Year
H_2S	hydrogen sulfide
HAP	High Accident Potential
HAR	Hawaii Administrative Rules
HAZMART	Hazardous Materials Pharmacy
HCF	Honolulu Control Facility
HDFAF	Homeland Defense Fighter Alert Facility
HIANG	Hawaii Air National Guard
Hz	Hertz
IICEP	Interagency and Intergovernmental Coordination for Environmental Planning
IRP	Installation Restoration Program
JDAM	Joint Direct Attack Munition
LBP	Lead-based Paint
LCZ	Landing Clear Zone
L_{dn}	Day-Night Average Sound Level
L_{dnmr}	Onset Rate-Adjusted Monthly Day-Night Average Noise Level
L_{eq}	Equivalent Sound Level
$L_{eq(24)}$	24-hour Equivalent Sound Level
$L_{eq(8)}$	8-hour Equivalent Sound Level
L_{max}	Maximum Sound Level
LRSOW	Long Range Stand-Off Weapons
MGD	million gallons per day
MILCON	Military Construction
MOA	Military Operations Area
mph	miles per hour
MSL	mean sea level
MTR	Military Training Route
NAAQS	National Ambient Air Quality Standards
NAVFAC HI	Naval Facilities Engineering Command, Hawaii
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NM	nautical mile
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
O&M	Operations and Maintenance
O_3	ozone
OSHA	Occupational Safety and Health Administration
P.L.	Public Law
PACAF	Pacific Air Forces
PAI	Primary Aircraft Inventory
Pb	lead
$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
PM_{10}	particulate matter less than 10 microns in diameter
ppb	parts per billion
ppm	parts per million
PSD	Prevention of Significant Deterioration
psf	pounds per square foot
psi	pounds per square inch
QD	quantity-distance
QDR	Quadrennial Defense Review
RCRA	Resource Conservation and Recovery Act
ROI	Region of Influence
SEL	Sound Exposure Level
SHPD	State Historic Preservation Division
SHPO	State Historic Preservation Office
SIC	Standard Industrial Code
SIP	State Implementation Plan
SO_2	sulfur dioxide
SO_x	sulfur oxides
SUA	Special Use Airspace
SWPCP	Stormwater Pollution Control Plan
SWPPP	Stormwater Pollution Prevention Plan
TPY	tons per year
U.S.	United States
UFC	Unified Facilities Criteria
USACE	United States Army Corps of Engineers
USBC	United States Bureau of the Census
USC	United States Code
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USNB	United States Naval Base
UTBNI	Up To But Not Including
VOC	volatile organic compound
WRCC	Western Regional Climate Center
WWTP	Wastewater Treatment Plant